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AREA SOURCE EMISSION INVENTORY (HYDROCARBON) CHEATHAM, DAVIDSON, ROBERTSON, RUTHERSFORD. SUMNER, WILLIAMSON, AND WILSON COUNTIES, TENNESSEE

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Cincinnati, Ohio

PREPARED FOR
Environmental Protection Agency, Atlanta, Ga.

July 1976

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~~HYDROCARBON~~ AREA SOURCE

EMISSION INVENTORY

~~FOR~~

CHEATHAM, DAVIDSON, ROBERTSON,
RUTHERSFORD, SUMNER, WILLIAMSON,
AND WILSON COUNTIES, TENNESSEE

Prepared for:

U.S. Environmental Protection Agency
Region IV, Atlanta, Georgia

Tennessee Department of Public Health
Division of Air Pollution Control

Metropolitan Health Department of
Nashville and Davidson County
Air Pollution Control Section

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This report is an inventory of all sources of hydrocabon emissions in a seven county study area centered around Nashville, Tennessee for the year 1974.

The annual hydrocarbon emissions from each source category have been calulated and allocated into grid squares for Davidson County. The survey data and emission estimating procedures used is presented in detail for each source category.

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SUMMARY

The purpose of this project was to prepare an inventory of all sources of hydrocarbon emissions in a seven county study area centered around Nashville, Tennessee for the year 1974. The counties included in this area are Cheatham, Davidson, Robertson, Rutherford, Summer, Williamson, and Wilson as shown in Figure 1.

Annual hydrocarbon emissions, as well as emissions during a typical winter day and a typical summer day, are summarized by category in Tables A through G for each county, respectively. Survey data and emission estimating procedures that were used to obtain these values for each source category are documented in detail in Sections 1 through 5 of this report. The list of source categories is conventional with the exception of industrial processes. Sources under this heading include paint, ink, cleaning solvents, dry cleaning operations, and service stations among others. Emissions from these sources cannot be categorized by the type of operation, since each source (e.g., solvents) may be used in several different industrial processes.

In Nashville-Davidson County, emissions from each source category were allocated into grid squares which cover the entire county, as shown in Figure 2. This grid system, which is a modified version of that used in the Nashville particulate emission inventory, is aligned to UTM

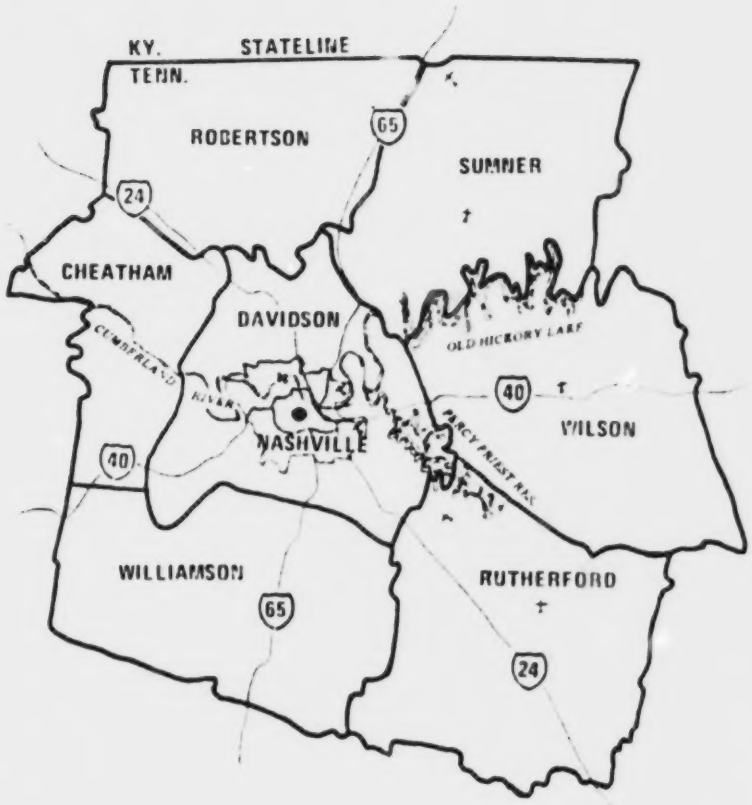

Figure 1. Hydrocarbon emission inventory study area.

Table A. CHEATHAM COUNTY AREA SOURCE HYDROCARBON EMISSIONS*

Source category	Emissions		
	Annual, tons	Winter day, lbs.	Summer day, lbs.
Fuel Combustion:			
Bituminous coal	6.9	92.0	0.1
Distillate oil	1.3	17.3	-
Residual oil	0.2	2.7	-
Natural gas	0.6	8.0	-
Other fuels	30.0	399.8	0.6
Waste Disposal & Unintentional Fires:			
Incineration	0.6	3.3	3.3
Open burning	8.1	18.5	2.3
Mobile Sources:			
Highway vehicles	947.1	5,695.1	4,710.3
Off-highway	99.2	-	721.5
Railroad	24.0	131.5	131.5
Aircraft	-	-	-
Vessels	24.3	133.2	133.2
Industrial Processes:	23.7	130.1	130.1
Total	1,166.0	6,631.5	5,832.9

*1974.

Table B. DAVIDSON COUNTY AREA SOURCE HYDROCARBON EMISSIONS*

Source category	Emissions		
	Annual, tons	Winter day, lbs.	Summer day, lbs.
Fuel Combustion:			
Bituminous coal	200.0	2,665.6	4.0
Distillate oil	31.4	418.5	0.6
Residual oil	5.3	70.6	0.1
Natural gas	59.6	794.3	1.2
Other fuels	58.9	785.0	2.1
Waste Disposal & Unintentional Fires:			
Incineration	4.0	21.9	21.9
Open burning	19.7	44.9	5.5
Mobile Sources:			
Highway vehicles	24,399.2	146,482.4	121,440.7
Off-highway	1,747.0	-	12,705.4
Railroad	307.0	1,682.2	1,682.2
Aircraft	134.7	738.1	738.1
Vessels	39.1	214.2	214.2
Industrial Processes:	7,350.1	40,274.6	40,274.6
Total	34,356.0	194,192.3	177,090.6

*1974.

Table C. ROBERTSON COUNTY AREA SOURCE HYDROCARBON EMISSIONS*

Source category	Emissions		
	Annual, tons	Winter day, lbs.	Summer day, lbs.
Fuel Combustion:			
Bituminous coal	33.7	449.2	0.7
Distillate oil	2.4	32.0	-
Residual oil	0.4	5.3	-
Natural gas	1.8	24.0	-
Other fuels	20.2	269.2	0.4
Waste Disposal & Unintentional Fires:			
Incineration	0.3	1.6	1.6
Open burning	13.7	31.2	3.8
Mobile Sources:			
Highway vehicles	1,888.3	11,334.0	9,405.6
Off-highway	291.3	-	2,118.6
Railroad	25.0	137.0	137.0
Aircraft	-	-	-
Vessels	-	-	-
Industrial Processes:	196.1	1,074.5	1,074.5
Total	2,473.2	13,358.0	12,742.2

*1974.

Table D. RUTHERFORD COUNTY AREA SOURCE HYDROCARBON EMISSIONS*

Source category	Emissions		
	Annual, tons	Winter day, lbs.	Summer day, lbs.
Fuel Combustion:			
Bituminous coal	30.4	405.2	0.6
Distillate oil	4.6	61.3	0.1
Residual oil	0.8	10.7	-
Natural gas	1.4	18.7	-
Other fuels	31.1	414.5	0.6
Waste Disposal & Unintentional Fires:			
Incineration	0.7	3.8	3.8
Open burning	13.2	30.1	3.7
Mobile Sources:			
Highway vehicles	3,815.1	22,995.5	18,903.9
Off-highway	347.2	-	2,525.1
Railroad	33.0	180.8	180.8
Aircraft	24.9	136.4	136.4
Vessels	-	-	-
Industrial Processes:	721.0	3,950.7	3,950.7
Total	5,023.4	28,207.7	25,705.7

*1974.

Table E. SUMNER COUNTY AREA SOURCE HYDROCARBON EMISSIONS*

Source category	Emissions		
	Annual, tons	Winter day, lbs.	Summer day, lbs.
Fuel Combustion:			
Bituminous coal	42.4	565.1	0.8
Distillate oil	5.1	68.0	0.1
Residual oil	0.8	10.7	-
Natural gas	2.1	28.0	-
Other fuels	64.8	863.7	1.3
Waste Disposal & Unintentional Fires:			
Incineration	0.8	4.4	4.4
Open burning	20.5	46.7	5.7
Mobile Sources:			
Highway vehicles	3,816.3	23,009.1	18,903.0
Off-highway	392.7	-	2,856.0
Railroad	56.0	306.8	306.8
Aircraft	19.8	108.5	108.5
Vessels	-	-	-
Industrial Processes:	435.7	2,387.2	2,387.2
Total	5,943.6	27,398.2	24,573.8

*1974.

Table F. WILLIAMSON COUNTY AREA SOURCE HYDROCARBON EMISSIONS*

Source category	Emissions		
	Annual, tons	Winter day, lbs.	Summer day, lbs.
Fuel Combustion:			
Bituminous coal	15.4	205.3	0.3
Distillate oil	3.1	41.3	0.1
Residual oil	0.5	6.7	-
Natural gas	1.5	20.0	-
Other fuels	133.1	1,773.9	2.6
Waste Disposal & Unintentional Fires:			
Incineration	0.2	1.1	1.1
Open burning	11.4	26.0	3.2
Mobile Sources:			
Highway vehicles	2,379.7	14,321.4	11,813.9
Off-highway	298.4	-	2,170.2
Railroad	42.0	230.1	230.1
Aircraft	-	-	-
Vessels	-	-	-
Industrial Processes:	324.7	1,779.1	1,779.1
Total	3,210.0	18,404.9	16,000.6

*1974.

Table G. WILSON COUNTY AREA SOURCE HYDROCARBON EMISSIONS*

Source category	Emissions		
	Annual, tons	Winter day, lbs.	Summer day, lbs.
Fuel Combustion:			
Bituminous coal	23.5	313.2	0.5
Distillate oil	3.4	45.3	0.1
Residual oil	0.6	8.0	-
Natural gas	2.3	30.7	-
Other fuels	45.9	611.8	0.9
Waste Disposal & Unintentional Fires:			
Incineration	0.3	1.6	1.6
Open burning	4.1	9.3	1.1
Mobile Sources:			
Highway vehicles	2,481.5	14,967.7	12,285.8
Off-highway	256.4	-	1,864.8
Railroad	31.0	169.9	169.9
Aircraft	4.2	23.0	23.0
Vessels	-	-	-
Industrial Processes:	329.9	1,807.6	1,807.6
Total	3,183.1	17,988.1	16,155.3

*1974.

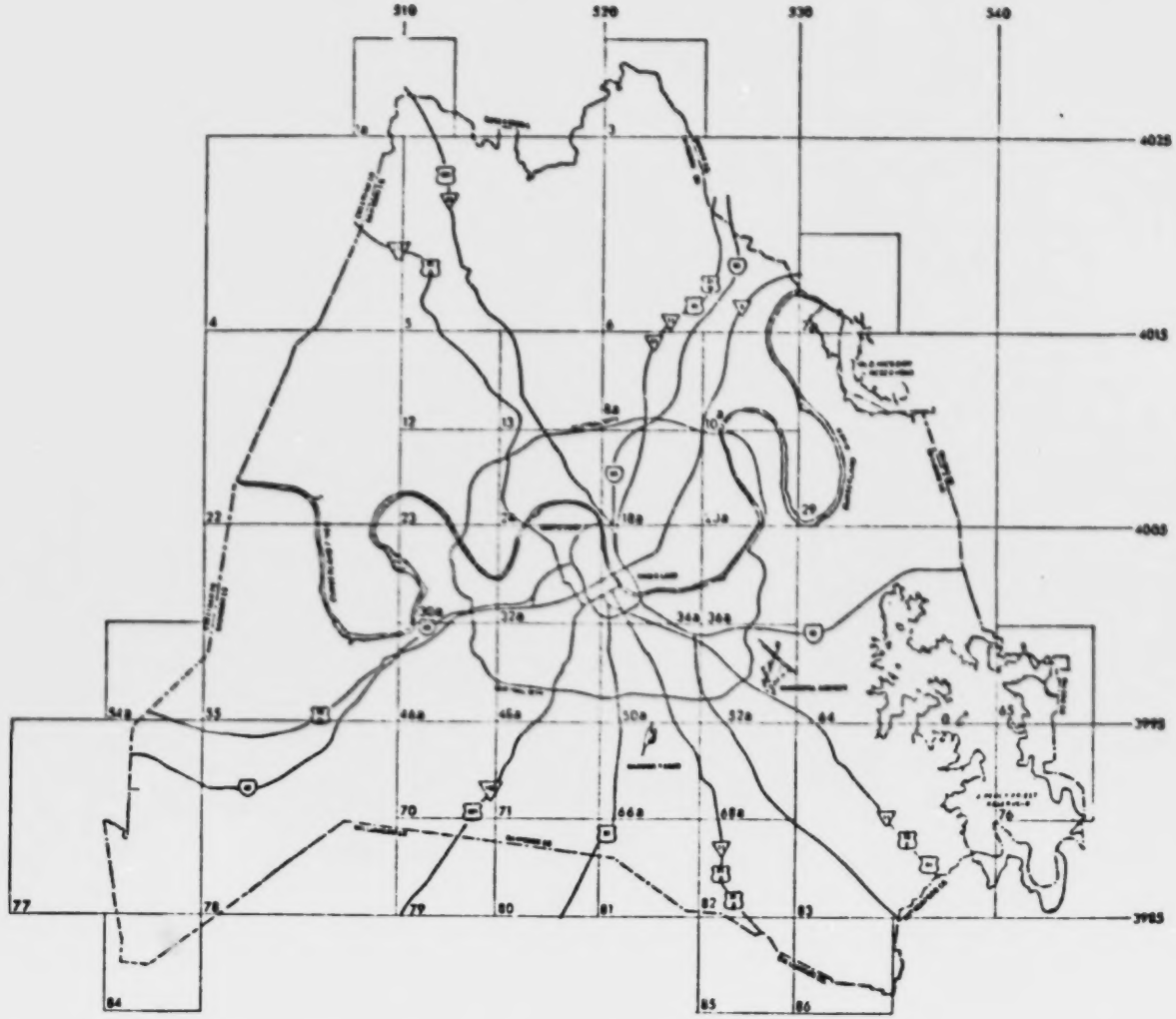

Figure 2. Nashville-Davidson county grid network

coordinates and consists of squares which are 5 km and 10 km on a side. This grid network contains 43 grids. The procedures used to allocate emissions from each source category to the grids are also explained in detail in Sections 1 through 5. The resulting total emissions by grid are presented in Appendix A.

Note grids having the subscript (a) correspond to a group of smaller grids in the particulate inventory. The number associated with each of these grids is the smallest grid number of the corresponding group of grids in the particulate inventory.

1. FUEL COMBUSTION

This category includes all fuel sources used for residential, commercial-institutional, and industrial heating. These sources are coal, distillate oil, residual oil, natural gas, LPG, and wood. Emissions from each of these source were calculated in each of the seven counties for a winter day, a summer day, and a year. Annual emissions were calculated by applying AP-42 emission factors to Bureau of Mines state fuel usage totals, which have been apportioned to counties by the appropriate census factors shown in Table 1-1. Point source totals, necessary for use in some categories, were obtained from the files of the state and county air pollution control offices.[25,21]

Annual emissions were apportioned to winter and summer by the number of heating degree-days per season. Typical daily emissions were obtained by dividing by the number of days in each season. The number of heating degree-days[14] in Nashville was 3,213 for the year 1974, with 1,927 of these in winter and 3 in summer. Winter was assumed to be 90 days (December, January, February) and summer to be 92 days (June, July, August). The daily seasonal factors are then:

$$\text{winter day factor} = \frac{1,927}{3,213} \times \frac{1}{90} = 666.4 \times 10^{-5}$$

$$\text{summer day factor} = \frac{3}{3,213} \times \frac{1}{92} = 1.0 \times 10^{-5}$$

Table 1-1. CENSUS FACTORS USED IN FUEL COMBUSTION APPORTIONING

County	Tennessee State Government Local Planning Office[2] July 1, 1974 population	1970 Census of Housing "Detailed Housing Characteristics"[6] Dwelling units coal	dist. oil	nat. gas	LPG	wood	Rooms per dwelling unit	1972 County Business Patterns[10] Mfg. employees	Non-building construction employees
Cheatham	16,100	316	149	355	443	277	4.9	1,528	45
Davidson	449,600	8,935	3,045	46,995	2,536	504	5.0	49,592	2,899
Robertson	31,600	1,537	364	2,593	952	183	4.9	2,519	63
Rutherford	66,800	1,356	1,057	2,661	1,864	274	5.0	4,705	155
Sumner	68,400	1,786	646	2,194	1,406	551	5.3	5,310	44
Williamson	43,300	660	346	2,432	1,246	1,163	5.2	2,550	527
Wilson	43,000	1,028	290	2,244	1,666	403	5.1	5,181	26
State	4,129,000	125,934	76,397	395,806	64,488	57,027	5.0	462,575	

1.1 BITUMINOUS COAL

County-wide Emissions

County coal usage was calculated by following the procedure oulined in APTD-1135[1] with the following input data, (e.g. Davidson County):

Residential:

Total county dwelling units using coal[6]	=	8,935 in 1970
Estimate 15 percent loss per year[20] Therefore, county dwelling units using coal	=	4,664 in 1974
Average rooms per dwelling unit[6]	=	5.0
National average rooms per dwelling unit[1]	=	5.0
Average annual heating degree-days[12]	=	3,578 (Nashville)
Ton coal per dwelling unit-degree-day[1]	=	0.0012
Total county residential coal consumption	=	$(4,664)(3,578)(0.0012)(\frac{5.0}{5.0})$
	=	20,025 ton/yr

Commercial-institutional:

Total state dwelling units using coal[6]	=	125,934 in 1970
Figure 15 percent loss per year[20]		
Therefore, state dwelling units using coal	=	65,738 in 1974
Average annual heating degree-days[12] (Average of Nashville, Knoxville, Memphis and Chattanooga; 65° Base)	=	3,407
Total state residential coal consumption	=	$(65,738)(3,407)(0.0012)(\frac{5.0}{5.0})$
	=	268,763 ton/yr

This figure is larger than that reported by the Bureau of Mines[3] (253,000) for state retail dealer sales in 1974. Therefore, commercial-institutional area source emissions were assumed to be negligible.

The values for heating degree-days used in the above calculations are consistent with those used in the particulate emission inventory for Nashville.[17] For the purpose of apportioning emissions to the winter and summer seasons in the base year of this study, the daily seasonal factors were calculated using the value for heating degree-days of the base year.

By comparison, contact with the major local coal distributor in Davidson County revealed total sales in 1973 of approximately 25,000 ton.[20] Customers were mainly residential, but included some commercial establishments. Since this distributor had no industrial customers, it was assumed that all industrial coal burners obtained carload shipments and would, therefore, be included as point sources. Thus, industrial coal combustion area source emissions were assumed to be negligible.

Since a majority of the coal distributor's sales were residential, an average emission factor of 20 lb/ton of coal (based on residential hand-fired units),[8] was applied to the calculated county-wide area source coal combustion. The hydrocarbon emissions were thus calculated to be 200 ton/yr for Davidson County.Table B

Emissions on a typical winter day are obtained by multiplying the annual emissions by the winter day factor. After converting to pounds the daily winter emissions are 2,665.6 lb. Similarly, the daily summer emissions are 4.0 lbs.

County-wide emissions for the seven counties observed in this inventory are summarized in Table 1-2.

Subcounty Distribution

Distribution of the area source hydrocarbon emissions from bituminous coal combustion in Davidson County was based upon grid population and information (pertaining to areas where coal is heavily used as a home or commercial heating fuel) obtained from the local coal distributor and the Nashville agency. The grids to which coal usage was allocated and the 1974 percentage of total emissions in each grid are shown below.

Table 1-2. HYDROCARBON EMISSIONS FROM COAL COMBUSTION*

County	Adjusted number dwelling units	Residential usage ton/yr	Emissions		
			Annual, tons	Winter day, lbs.	Summer day, lbs.
Cheatham	165	694	6.9	92.0	0.1
Davidson	4,664	20,025	200.0	2,665.6	4.0
Robertson	802	3,375	33.7	449.2	0.7
Rutherford	708	3,040	30.4	405.2	0.6
Sumner	932	4,242	42.4	565.1	0.8
Williamson	344	1,536	15.4	205.3	0.3
Wilson	537	2,352	23.5	313.2	0.5

*1974.

Table 1-3. PERCENTAGE BITUMINOUS COAL DISTRIBUTION BY GRIDS, 1974

Grid	% of Total	Grid	% of Total
18a	8.00	32a	37.52
24	5.56	34a	30.04
30a	8.48	48a	10.40

1.2 DISTILLATE OIL

County-wide Emissions

Two sources of information were used to evaluate the impact of distillate oil fuel combustion by area sources:

1. A survey of several local fuel oil dealers indicated sales of approximately 1,250,000 gallons to nearly 1,000 homes. The total number of dwelling units in Davidson County using distillate oil was 3,045 in 1970.[6] This represents 2 percent of the total county housing. Since oil usage is not rapidly changing, it was assumed that dwelling units using distillate oil would remain constant through 1974. For 3,045 homes, distillate fuel oil residential usage would amount to $3,806 \times 10^3$ gal/yr.

2. County consumption of distillate oil was also calculated by the degree-day method previously described for coal.

Residential:

Heating requirement factor for distillate oil[1] = 0.18 gal/dwelling unit-degree-day

County residential distillate oil consumption = $(3,045)(3,578)(.18)(\frac{5.0}{5.0})$

= 1,961,000 gal/yr

The estimate of 3,806 x 10^3 gal, based upon data obtained from the survey of distributors, was considered to be more indicative of the actual residential distillate oil consumption. By applying an average emission factor of 3 lb/10^3 gal of oil to this estimate, hydrocarbon emissions are estimated to be 5.7 ton/yr (residential).

For the remaining six counties the degree-day method was used since no dealer information was available.

Commercial-institutional:

To obtain the commercial-institutional distillate oil usage, the following state data were used:

Kerosene used for heating[4]	=	2,497,000 bbl x 42
	=	104,874,000 gal
Distillate type heating oils[4]	=	1,843,000 bbl x 42
	=	77,406,000 gal
Distillate used by military	=	186,000 bbl x 42
	=	7,812,000 gal

Total state residential and commercial-institutional distillate oil consumption = 190,092,000 gal

This total fuel usage, when apportioned to the counties by population, equals:[2]

Total county residential and commercial-institutional distillate oil consumption $= (190,092,000)\left(\frac{449,600}{4,129,000}\right)$

$= 20,699,000$ gal/yr

Subtracting the county residential usage of distillate oil from the above consumption,

Total county commercial-institutional usage = 20,699,000 - 3,806,000
= 16,893,000 gal/yr

There are no commercial-institutional point sources in Davidson County using distillate oil.[21] Therefore, the commercial-institutional area source county consumption of distillate oil is 16,893,000 gal/yr. An average emission factor of 3 lb/10^3 gal of oil, when applied to the above consumption, produces estimated hydrocarbon emissions of 25.3 ton/yr (commercial-institutional).

Point source figures for the other six counties were obtained from Reference 25.

Industrial:

Industrial consumption of distillate oil was determined using the following state data from Reference 4:

Industrial = 1,245,000 bbl x 42 = 52,290,000 gal
Oil Co. = 207,000 bbl x 42 = 8,694,000 gal
Total state industrial distillate oil usage = 60,984,000 gal

This total, when apportioned to the counties by number of manufacturing employees, equals:[10]

Total county industrial distillate oil usage = $(60,984,000)(\frac{49,592}{462,575})$
= 6,538,000 gal/yr

Subtracting the industrial point source usage of 6,271,880 gal/yr[21] from this amount gives an area source distillate oil consumption of 266,120 gal/yr in the county. Point source figures for the remaining six counties were obtained from Reference 25.

Applying an average emission factor of 3 lb/10^3 gal of oil, hydrocarbon emissions amount to 0.4 ton/yr (industrial).

The Davidson County area source hydrocarbon emissions resulting from combustion of distillate oil are:

Residential	5.7 ton/yr
Commercial-institutional	25.3 ton/yr
Industrial	0.4 ton/yr
Total particulate emissions	31.4 ton/yr

Total emissions and daily winter and summer emissions for the seven counties are shown in Table 1-4.

Subcounty Distribution

Emissions were apportioned to the grids in Davidson County based upon grid population where commercial-institutional activity was indicated on land use planning maps. This formula heavily weighted the lower density suburban commercial developments. However, fuel oil probably has a greater share of the fuel market in these suburban areas, resulting in a reasonably accurate allocation.

Table 1-4. HYDROCARBON EMISSIONS FROM DISTILLATE OIL COMBUSTION*

County	Distillate oil use, 10^3 gal/yr				Emissions		
	Residential	Commercial-Institutional	Industrial	Total	Annual, tons	Winter day, lbs.	Summer day, lbs.
Cheatham	94	674	96	864	1.3	17.3	Neg.**
Davidson	3,806	16,893	266	20,965	31.4	418.5	0.6
Robertson	230	1,225	123	1,578	2.4	32.0	Neg.
Rutherford	681	2,394	-	3,075	4.6	61.3	0.1
Sumner	441	2,708	224	3,373	5.1	68.0	0.1
Williamson	232	1,761	53	2,046	3.1	41.3	0.1
Wilson	190	1,790	264	2,244	3.4	45.3	0.1

** Summer day emissions less than 0.05 lbs. were considered negligible.

* 1974.

1.3 RESIDUAL OIL

County-wide Emissions

Data for total state consumption of residual fuel oil were obtained from Bureau of Mines data[4] and the allocation methods described in Ref. 1 were followed.

Residential:

Contact with several major local fuel oil distributors indicated that there was no residential usage of residual oil in Davidson County.

Commercial-institutional:

The total state consumption of residual fuel oil for the commercial-institutional sector is the combination of:

Residual type heating oils[4] = 490,000 bbl x 42 = 20,580,000 gal
Residual used by military[4] = 63,000 bbl x 42 = 2,646,000 gal
Total state commercial-institutional residual oil consumption = 23,226,000 gal/yr

The total fuel usage when apportioned to the counties by population, equals:[2]

$$\text{Total county commercial-institutional residual} = (23,226,000)\left(\frac{449,600}{4,129,000}\right)$$
$$= 2,529,000 \text{ gal/yr}$$

There are no commercial-institutional point sources in Davidson County using residual oil.[21] Therefore, the commercial-institutional area source county consumption of

residual oil is 2,529,000 gal/yr. Using an average emission factor of 3 lb/10^3 gal, the hydrocarbon emissions amount to 3.8 ton/yr (commercial-institutional).

Industrial:

The industrial residual oil consumption is a combination of the following type of usage:

Industrial[4]	= 300,000 bbl x 42 =	12,600,000 gal
Oil Co.[4]	= 19,000 bbl x 42 =	798,000 gal
Total state industrial residual oil usage	=	13,398,000 gal/yr

This total was apportioned to the counties by number of manufacturing employees,[10]

$$\text{Total county industrial residual oil usage} = (13{,}398{,}000)\left(\frac{49{,}592}{462{,}575}\right) = 1{,}436{,}380 \text{ gal/yr}$$

Subtracting the industrial point source usage of 429,577 gal/yr[21] from this amount gives a county area source residual oil consumption of 1,006,803 gal/yr. Applying an average emission factor of 3 lb/10^3 gal of oil, hydrocarbon emissions equal 1.5 ton/yr (industrial).

The Davidson County area source hydrocarbon emissions resulting from combustion of residual oil are:

Commercial-institutional	3.8 ton/yr
Industrial	1.5 ton/yr
Total hydrocarbon emissions	5.3 ton/yr

Total emissions and daily winter and summer emissions for the seven counties are shown in Table 1-5.

Table 1-5. HYDROCARBON EMISSIONS FROM RESIDUAL OIL COMBUSTION*

County	Residual oil usage, 10^3 gal/yr			Emissions		
	Commercial-Institutional	Industrial	Total	Annual, tons	Winter day, lbs.	Summer day, lbs.
Cheatham	91	44	135	0.2	2.7	Neg. **
Davidson	2,529	1,007	3,536	5.3	70.6	0.1
Robertson	178	73	251	0.4	5.3	Neg.
Rutherford	376	136	512	0.8	10.7	Neg.
Sumner	385	154	539	0.8	10.7	Neg.
Williamson	244	74	318	0.5	6.7	Neg.
Wilson	242	150	392	0.6	8.0	Neg.

** Summer day emissions less than 0.05 lbs. were considered negligible.

* 1974.

Subcounty Distribution

Emissions were apportioned to the grids in Davidson County based upon the amount of commercial-institutional and industrial land use in each grid. This would tend to more heavily weight the lower density suburban commercial and industrial developments. This was considered to be a reasonably accurate distribution since fuel oil probably has a greater share of fuel market in the suburban areas.

1.4 NATURAL GAS

County-wide Emissions

Davidson County natural gas usage was determined by following the procedure outlined in Reference 1 and the use of the following data:

Residential:

Total county dwelling units using natural gas[6]	=	46,995 in 1970
Approx. 5.4 percent increase[22]	=	58,000 in 1974
Total state dwelling units using natural gas[6]	=	395,806 in 1970
With same 5.4 percent increase	=	488,000 in 1974
Total state residential natural gas consumption[5]	=	$43,586 \times 10^6$ cu.ft.

Total county residential natural gas consumption is obtained by apportioning the state total consumption by number of dwelling units.

Total county residential natural gas consumption $= 43,586 \times 10^6 (\frac{58,000}{488,000})$

$= 5,180.3 \times 10^6$ cu.ft/year

Based on the natural gas distributor's total sales and Davidson County sales (90% of total) in 1973,[22] the consumption of natural gas in Davidson County in 1973 was:

Residential & public housing	$= 6,086 \times 10^6 (.9)$	$= 5,477 \times 10^6$ cu.ft.
Commercial	$= 6,100 \times 10^6 (.9)$	$= 5,490 \times 10^6$ cu.ft.
Industrial	$= 22,495 \times 10^6 (.9)$	$= 20,245 \times 10^6$ cu.ft.

The calculated natural gas residential usage value agrees very well with the value from the distributor and was used in the emission computation. Using an average emission factor of 8 lb/10^6cu.ft., based upon domestic heating, hydrocarbon emissions from residential natural gas users amounted to 20.7 ton/yr (residential).

Commercial-institutional:

To check commercial-institutional fuel consumption,

State commercial sales[5]	$= 40,685 \times 10^6$ cu.ft.
State other consumers	$= 3,966 \times 10^6$ cu.ft.
Total state commercial-institutional natural gas consumption	$= 44,651 \times 10^6$ cu.ft.

Apportioning to the counties by population,[2]

Total county commercial-institutional natural gas $= (44,651 \times 10^6)(\frac{449,600}{4,129,000})$

$= 4,862.5 \times 10^6$ cu.ft./yr

Subtracting the county commercial-institutional point source usage of 559 x 10^6 cu.ft. of natural gas,[21] the area source commercial-institutional consumption is equal to 4,263.5 x 10^6 cu.ft/yr.

Using the natural gas distributor's figure of 5,490 x 10^6 cu.ft. and subtracting the point source usage, county commercial-institutional area source consumption is 4,931 x 10^6 cu.ft./yr. Applying 8 lb/10^6 cu.ft. as the emission factor based upon commercial heating, the area source hydrocarbon emissions equal 17.1 ton/yr (commercial-institutional).

Industrial:

The industrial consumption of natural gas was also checked by apportioning the state total industrial usage[5] of 146,863 x 10^6 cu.ft. by the number of manufacturing employees:[10]

Total county industrial
Natural gas consumption $= (146,863 \times 10^6)(\frac{49,592}{462,575})$

$= 15,745 \times 10^6$ cu.ft./yr

Subtracting the industrial point source usage of 5,740 x 10^6 cu.ft. per year[21] from this amount gives an area source natural gas consumption of 10,005 x 10^6 cu.ft./yr in the county.

Using the gas distributor's figure of 20,245.5 x 10^6 cu.ft. and subtracting the point source usage, county industrial area source consumption is 14,505.5 x 10^6 cu.ft./yr. Using this value and an average industrial emission factor of 3 lb/10^6 cu.ft., the hydrocarbon emissions equal 21.8 ton/yr (industrial).

The Davidson County area source hydrocarbon emissions resulting from natural gas combustion in Davidson County are:

Residential	20.7 ton/yr
Commercial-institutional	17.1 ton/yr
Industrial	21.8 ton/yr
Total hydrocarbon emissions	59.6 ton/yr

Winter day, summer day, and annual emissions for all counties are listed in Table 1-6.

Subcounty Distribution

Emissions resulting from natural gas combustion in Davidson County were distributed separately by subcategory. Residential emissions from natural gas usage were distributed to all grids based upon grid populations for each study year.

The land use planning map was used to indicate areas of significant commercial and industrial activity. Emissions were then allocated to the appropriate grids based upon population for the commercial-institutional subcategory and approximate land area for the industrial subcategory.

1.5 OTHER FUELS

1.5.1 LPG

County-wide Emissions

LPG fuel consumption in Davidson County was determined by following the method outlined in Reference 1 and using the state data from Reference 7.

Table 1-6. HYDROCARBON EMISSIONS FROM NATURAL GAS COMBUSTION*

County	Adjusted No. dwelling units	Natural gas usage, 10^6 cu.ft/yr			Emissions		
		Residential	Commercial/ institutional	Industrial	Annual, tons	Winter day, lbs.	Summer day, lbs.
Cheatham	438	39.1	Neg.	285.4	0.6	8.0	Neg.**
Davidson	58,000	5,180.3	4,263.5	14,505.5	59.6	794.3	1.2
Robertson	3,200	285.8	Neg.	405.7	1.8	24.0	Neg.
Rutherford	3,284	293.3	Neg.	162.5	1.4	18.7	Neg.
Sumner	2,708	241.9	Neg.	787.8	2.1	28.0	Neg.
Williamson	3,001	268.0	10.5	276.2	1.5	20.0	Neg.
Wilson	2,769	247.3	Neg.	854.5	2.3	30.7	Neg.

* 1974.

** Summer day emissions less than 0.05 lbs. were considered negligible.

Total commercial and residential LPG and ethane gas consumption = 122,663,000 gal/yr

Natural gas ratio $= \frac{\text{state residential usage}}{\text{state commercial usage}} = 1$

Therefore, it is assumed that total state residential LPG usage and total state commercial LPG usage each approximately equal 61,331,500 gal/yr.

Residential:

The Davidson County residential LPG usage, when apportioned by dwelling units using LPG,[6] equals:

$$\text{Residential LPG usage} = (61,331,500)\left(\frac{2,536}{64,488}\right)$$

$$= 2,411,870 \text{ gal/yr}$$

It is assumed that the dwelling unit ratio for 1974 is the same as for 1970.

Commercial-institutional:

The Davidson County commercial-institutional LPG usage, when apportioned by population[2] equals:

$$\text{Commercial-institutional LPG usage} = (61,331,500)\left(\frac{449,600}{4,129,000}\right)$$

$$= 6,678,286 \text{ gal/yr}$$

Total Davidson County residential and commercial-institutional LPG consumption equals 9,090,156 gal/yr.

An average emission factor for domestic or commercial LPG fuel consumption is 0.8 $lb/10^3$ gal. When applied to the above LPG consumption, hydrocarbon emissions amount to 3.6 ton/yr (residential and commercial-institutional).

Industrial:

Industrial LPG usage was obtained by apportioning the state total[7] of 6,330,000 gal by the number of manufacturing employees.[10]

$$\text{Total county industrial LPG consumption} = (6,330,000)\left(\frac{49,592}{462,575}\right)$$

$$= 678,630 \text{ gal/yr}$$

An average emission factor for industrial LPG usage is 0.3 $lb/10^3$ gal. Thus, hydrocarbon emissions from the combustion of LPG in 1974 was 0.1 ton/yr.

Winter day, summer day and annual emissions for all counties are shown in Table 1-7.

Subcounty Distribution

Since the percentage of urban LPG users (2,384 out of 2,536 homes) aligns closely with the percentage of urban population,[6] allocation of the emissions from this category in Davidson County were made to all grids proportional to their population.

Table 1-7. HYDROCARBON EMISSIONS FROM LPG AND WOOD COMBUSTION*

County	LPG usage, 10^3 gal/yr		LPG emissions			Wood usage, ton/yr	Wood emissions		
	Residential and commercial-institutional	Industrial	Annual, tons	Winter day, lbs.	Summer day, lbs.	Residential	Annual, tons	Winter day lbs.	Summer day lbs.
Cheatham	660	21	0.3	4.0	Neg.**	1,651	29.7	395.8	0.6
Davidson	9,090	679	3.7	49.3	1.0	3,066	55.2	735.7	1.1
Robertson	1,375	34	0.6	8.0	Neg.	1,091	19.6	261.2	0.4
Rutherford	2,765	64	1.1	14.7	Neg.	1,667	30.0	399.8	0.6
Sumner	2,353	73	0.9	12.0	Neg.	3,553	63.9	851.7	1.3
Williamson	1,828	35	0.7	9.3	Neg.	7,357	132.4	1,764.6	2.6
Wilson	2,223	71	0.9	12.0	Neg.	2,500	45.0	599.8	0.9

** Summer day emissions less than 0.05 lbs. were considered negligible.

* 1974.

1.5.2 Wood

County-wide Emissions

Residential:

Residential wood usage was calculated using the method described in Reference 1.

Total county dwelling units using wood as a home heating fuel[6]	=	504 in 1970
Assume constant for 1974		
Average rooms per dwelling unit[6]	=	5.0
National average rooms per dwelling unit[1]	=	5.0
Average annual heating degree days[12]	=	3,578 for Nashville
Ton of wood per dwelling unit-degree day[1]	=	.0017
Total county residential wood consumption	=	$(504)(3,578)(.0017)(\frac{5.0}{5.0})$
	=	3,066 ton/yr

Applying an average emission factor of 36 lb/ton of wood burned, hydrocarbon emissions from this source category are

55.2 ton/yr.

Commercial-institutional and Industrial:

There were no data available to indicate the use of wood fuel by commercial-institutional area sources. It is expected to be quite minimal. Wood burning by the industrial sources is done as wood waste burning by the wood industry and these are included as point sources. Therefore, commercial-institutional and industrial area source emissions were considered to be negligible.

Table 1-7 shows winter day, summer day and annual emissions for each county.

Subcounty Distribution

Allocation of emissions resulting from residential wood burning in Davidson County was based upon 64 percent of the homes using wood as a home heating fuel being in the urban area.[6] The same grids used for coal distribution were used for the wood distribution, with these grids receiving 64 percent of the emissions. The remainder was distributed to the area outside the central city in proportion to population.

2. ON-SITE INCINERATION

County-wide Emissions

A listing of all known non-point source incinerators in Davidson County and the amount of refuse burned in each was recently compiled by the Metro agency. This listing is shown in Appendix B. Previous surveys of incinerators in early 1973 and 1974 only estimated the amount of refuse burned in each unit rather than obtaining this information by contacting the operators, as was done in the most recent survey. While the data in Appendix B are representative of 1975, not the base year 1974, they probably provide the best available estimate of the 1974 refuse burning rates for the incinerators still in operation. However, the total refuse burned would be low because several incinerators were shut down during 1974.

The 1975 emissions were calculated first, as follows: commercial and institutional incinerators were estimated to burn at the indicated rates for 365 days/yr, and industrial sources were estimated to burn 260 days/yr (5 days/wk), disposing of a total of 2,470 ton of waste per year in on-site incinerators. All of the incinerators are multiple chamber, so an average emission factor of 3 lb/ton of refuse was applied. The hydrocarbon emissions were calculated to be 3.7 ton/yr.

To estimate 1974 emissions, it was assumed that emissions from this source category would be directly proportional to

the number of on-site incinerators in use, or that the incinerators shut down had the same average burning rate as those still in operation. The numbers of incinerators inventoried in each of the past two surveys are:

April 1974	78	(8 of these had apparently stopped burning at the time of the survey but have since resumed)
January 1975	72	

Therefore, the 1974 emissions were: $\frac{78}{72}$ (3.7) = 4.0 ton/yr.

The number of incinerators in the other six counties was obtained from the State Division of Air Pollution Control.[25] It was assumed that each incinerator burned on an average 205 pounds of refuse per day and operate 365 days/yr. The average emission factor for single chamber incinerators, of which there are three, is 15 lb/ton of refuse burned.

Incinerators were assumed to maintain the same operation year round. Emissions (annual, winter day, summer day) for all counties are shown in Table 2-1.

Subcounty Distribution

The street addresses of all the on-site incinerators are available (see Appendix B). Therefore, emissions for 1975 have been allocated directly to the appropriate grids in Davidson County by totaling the amount of refuse burned and resulting emissions in each grid.

Table 2-1. HYDROCARBON EMISSIONS FROM ON-SITE INCINERATION*

County	Single chamber incinerators		Multi-chamber incinerators				Emissions		
	Number	Tons burned/yr	Number commercial-institutional	Tons burned/yr	industrial	Tons burned/yr	Annual, tons	Winter day, lbs.	Summer day, lbs.
Cheatham	2	74.8					0.6	3.3	3.3
Davidson			71	2,400	4	267	4.0	21.9	21.9
Robertson			5	187			0.3	1.6	1.6
Rutherford	1	37.4	7	262			0.7	3.8	3.8
Sumner			15	561			0.8	4.4	4.4
Williamson			3	112			0.2	1.1	1.1
Wilson			5	187			0.3	1.6	1.6

* 1974.

3. OPEN BURNING

County-wide Emissions

On-site open burning of trash has been illegal in Davidson County for several years. Along with this, leaf burning inside the urban services area is prohibited.

There are three classifications, however, that should be considered in this category: a) leaf burning outside the urban services area, b) unintentional field fires and c) unintentional structural fires.

a) The residential area outside the urban services area was considered to include primarily older rural homes, where leaf raking is often not done, and newer suburban development homes, where trees are rarely large enough to produce enough leaves to require raking and burning. This, therefore, was considered a negligible category.

b) In 1974, 10 unintentional field fires burned 102 acres in Davidson County, according to the Tennessee Department of Conservation, Division of Forestry. This acreage is primarily thinly forested or brushy, amounting to an average growth of 8 ton/acre. This value was determined based on contact with the Southern Forest Fire Laboratory.[19] The emission factor for agricultural field and wood burning is 20 lb/ton of growth. The resulting emissions are 8.2 ton/yr.

c) Unintentional structural fires in 1974 numbered 932 in the urban services area, according to the Metro Fire Marshall's Office. Since 97 percent of the county population and housing is urban,[6] the total number of structural fires in the county was proportioned upward to equal 961 fires. Assuming no catastrophic fires, an average factor of 5 tons of wood burned per fire, an engineering judgment of PEDCo-Environmental, was used. This factor, when multiplied by an emission factor of 4 lb/ton of wood burned produces hydrocarbon emissions of 9.6 ton/yr.

The Metro Fire Marshall also reports 751 grass and trash fires in 1974. No breakdown between the number of each type was available. Therefore, it was assumed that all fires of this type were the equivalent of burning one-half acre per fire and one-half ton per acre. Proportioning the number of fires upward and applying the emission factor of 20 lb/ton burned, the hydrocarbon emissions from fires in this category in Davidson County were 1.9 ton/yr. Total hydrocarbon emissions from open burning in Davidson County in 1974 were 19.7 ton/yr.

The remaining six counties do not have the services of a large metropolitan fire department as does Davidson County. Fire records would be difficult to obtain from the many local volunteer departments. Therefore, the number of structural and grass and trash fires in these counties was made proportional to those in Davidson County by population. The Division of Forestry provided information on the number of field fires in these other counties.

To determine winter and summer daily emissions, the Division of Forestry also provided state-wide information on the

number of fires per month for 1974. Of the total number of fires in Tennessee, 88.4 percent occurred in the spring-fall seasons, 10.3 percent in the winter, and only 1.3 percent in the summer. By dividing by the number of days in each season, the winter day factor is calculated to be 0.00114, and the summer day factor is 0.00014. Winter day, summer day, and annual emissions for all seven counties are shown in Table 3-1.

Subcounty Distribution

In Davidson County, open burning emissions from unintentional field fires were apportioned to grids outside the urban services area based on the land use policy plan. Areas of non-urban open space and half of the areas of low-medium density residential were used to proportionately distribute the emissions to the appropriate grids.

Emissions resulting from unintentional structural fires and grass and trash fires were distributed to grids inside the urban services area proportional to each grid's base year population.

Table 3-1. HYDROCARBON EMISSIONS FROM OPEN BURNING*

County	Field fires			Structural fires		Grass and trash fires			Emissions		
	No. fires	Acres burned	Tons burned	No. fires	Tons burned	No. fires	Acres burned	Tons burned	Annual, tons	Winter day, lbs.	Summer day, lbs.
Cheatham	19	96	768	34	170	28	14	7	8.1	18.5	2.3
Davidson	10	102	816	961	4,805	774	387	194	19.7	44.9	5.5
Robertson	33	161	1,288	68	340	54	27	14	13.7	31.2	3.8
Rutherford	14	143	1,144	143	716	115	58	29	13.2	30.1	3.7
Sumner	20	234	1,872	146	730	113	56	28	20.5	46.7	5.7
Williamson	24	128	1,024	93	465	74	37	19	11.4	26.0	3.2
Wilson	9	37	296	92	460	71	36	18	4.1	9.3	1.1

* 1974.

4. MOBILE SOURCES

This category includes emissions from all on-highway vehicles (cars, trucks), all off-highway vehicles (farm tractors, construction equipment), and all railroad, aircraft and vessel activity. The methods for calculating the emissions from each source are described in each section, respectively.

4.1 HIGHWAY VEHICLES

County-wide Emissions

This category includes automobiles, light-duty vehicles, heavy-duty gasoline-powered trucks, and heavy-duty diesel-powered trucks. Emissions factors were calculated by following the method described in the AP-42 Supplement 5 Section on highway vehicles.[9] The basic equation for these calculations is:

$$E = \sum_i (ZCx_i M_i V_i + Ce_i M_i)$$

where,

E is the composite emission factor in grams per mile,
Cx is a nationwide average exhaust emission factor in grams per mile dependent on vehicle age i,
Ce is a sum of nationwide average evaporative and crankcase emission factors in grams per mile dependent on vehicle age i,
M is a weighted percentage of annual travel of a given vehicle type dependent on vehicle age i,
V is a speed correction factor dependent on the average speed, type of road, vehicle type, and vehicle age i,
Z is a temperature correction factor dependent on the season of the year.

The variables Cx and Ce were was obtained from tables in Supplement 5. The tables to be used depend on the type of vehicle and the base year of the study. The average emission factors are dependent on the age of the vehicles. These factors are listed for 13 model years, the last being for any vehicle over 12 years of age.

The variable M is calculated from a distribution of vehicles by age[33] and the average annual miles traveled by vehicles of each age. The value of M is age dependent and is equal to the product of the number of vehicles of age i times the average annual miles driven by vehicles of age i, divided by the sum of these products for the 13 model years.

The variable V is determined from the equation

$$V = e^{(A+BS+CS^2)}$$

where, e is the base of natural logarithms,

A,B,C are constants dependent on vehicle age, obtained from tables in Supplement 5, which are dependent on vehicle type, and

S is the average speed in miles per hour.

The average speed will be different on different types of roads (freeway, arterial, local) within a county. Nashville - Davidson County has also been divided into three regional areas - central business district, central city, and suburban. Therefore, in Nashville, there will be nine different average speeds, each leading to speed correction factors which vary with vehicle age.

The average speeds used in this study are shown in Table 4-1, and were derived from information supplied by the Tennessee DOT (Department of Transportation).[24]

Table 4-1. AVERAGE SPEEDS ON NASHVILLE ROADS IN MILES PER HOUR*

Regional area	Road type Freeway	Arterial	Local
CBD, Central Business District	50	20	10
CC, Central City	55	25	15
Sub, Suburban	55	35	20

* 1974.

All other counties were assumed to be suburban regional areas, and only those average speeds were used in determining their speed correction factors.

The variable Z is calculated using the equation

$$Z = -0.0113(t) + 1.81$$

where, t is the average temperature in degrees Farenheit by season.

For 1972, these temperatures in Nashville were 43 degrees in winter, and 76 degrees in summer, leading to temperature correction factors of 1.32 and 0.95, respectively.

Total annual vehicle miles traveled (VMT) were determined by apportioning state petroleum tax figures[26] by population to each of the six counties surrounding Davidson County, dividing by the tax rate to get gallons, and multiplying by 12.2 miles per gallon. Total daily VMT in Davidson County were obtained from the state DOT rather than using the petroleum tax method. These VMT figures were the same as

those used in SAPOLLUT, a computer program developed by the Urban Planning Division of the U.S. Department of Transportation. Thus, the emissions estimated by the Federal Test Procedure (Supplement 5) can be compared to emissions estimated by SAPOLLUT.

The VMT figure for Davidson County was broken down to indicate the VMT in the three regional areas: central business district, central city and suburban. The other six counties were all assumed to be suburban regional areas.

The percentage of travel by vehicle type was determined from the same data used to calculate the variable M. The ratio of the sum of the products for each type of vehicle to the total of these sums is the percentage of travel by each vehicle type.

Detailed emission factors and emissions for Davidson County and the six contiguous counties are shown in Appendix C. Inspection of these calculated emission factors shows that on a per-mile basis heavy-duty gasoline trucks are the greatest source of hydrocarbon emissions, followed by light-duty trucks, automobiles, and heavy-duty diesel trucks.

Annual emissions and typical winter day and summer day emissions are shown in Table 4-2 for the seven counties. In Table 4-3, the total annual emissions are broken down by vehicle type.

In Table 4-4, the Davidson County annual emissions calculated by the Supplement 5 method are compared to those calculated by the SAPOLLUT model by regional area and road type. The SAPOLLUT program overall shows lower emissions. This may be

caused, to some extent, by the different VMT distributions to freeway, arterial and local roads within each regional area used by each method, although the total VMT in each area were the same. The major difference, however, is due to the fact that SAPOLLUT basically follows the methods outlined in Supplement 2. The speed correction factors for hydrocarbons in Supplement 2 are obtained from one curve only. These factors in Supplement 5 are determined from a family of curves, each one dependent upon vehicle type and vehicle age. Also SAPOLLUT does not account for differences in temperature where Supplement 5 does.

Table 4-2. HYDROCARBON EMISSIONS FROM HIGHWAY VEHICLES*

County	Emissions		
	Annual, ton	Winter day, lbs	Summer day, lbs
Cheatham	947.1	5,695.1	4,710.3
Davidson	24,399.2	146,482.4	121,440.7
Robertson	1,888.3	11,334.0	9,405.6
Rutherford	3,815.1	22,995.5	18,903.9
Sumner	3,816.3	23,009.1	18,903.0
Williamson	2,379.7	14,321.4	11,813.9
Wilson	2,481.5	14,967.7	12,285.8

* 1974.

Table 4-3. HYDROCARBON EMISSIONS BY VEHICLE TYPE*

County	Emissions, ton/yr			
	Automobiles	Light-duty trucks	H.D. gasoline trucks	H.D. diesel trucks
Cheatham	561.7	285.5	85.8	14.1
Davidson	18,000.0	3,614.4	2,377.8	407.0
Robertson	1,156.0	494.4	205.7	32.2
Rutherford	2,659.3	833.9	277.9	44.0
Sumner	2,649.6	863.5	261.4	41.8
Williamson	1,609.7	539.2	198.3	32.4
Wilson	1,704.8	584.3	166.5	25.9

* 1974.

Table 4-4. COMPARISON OF DAVIDSON COUNTY HIGHWAY VEHICLE EMISSIONS CALCULATED BY SAPOLLUT AND SUPPLEMENT 5*

Regional area	Road type	Annual emissions, ton	
		SAPOLLUT	Supplement 5
CBD	Freeway	1,112.9	1,266.5
	Arterial	710.5	1,026.3
	Local	19.3	301.3
Total CBD		1,842.7	2,594.1
Central City	Freeway	2,450.4	2,904.2
	Arterial	3,511.7	5,258.6
	Local	194.9	2,751.6
Total CC		6,157.0	10,914.4
Suburban	Freeway	2,514.1	3,132.6
	Arterial	4,573.8	6,157.2
	Local	102.4	1,600.9
Total SUB		7,190.3	10,890.7
County Total		15,190.0	24,399.2

* 1974.

Subcounty Distribution

The distribution of emissions from all motor vehicle sources was based upon county VMT by road type in each regional area. We assumed that the VMT in each grid in 1974 would be proportional to that in 1973. Therefore, the emission distributions shown in the Particulate Area Source Emission Inventory for Nashville - Davidson County, Tennessee[17] were used to apportion vehicle emissions to grids for 1974. Grid emissions by vehicle type are shown in Appendix D.

4.2 OFF-HIGHWAY

County-wide Emissions

This category includes off-highway vehicles and machinery using diesel and gasoline fuels. Typical gasoline fuel users are farm tractors, lawnmowers, compressors, pumps and small electric generators. Typical diesel fuel users are farm tractors, construction equipment, emergency generator power units, and compressor engines.

Gasoline Usage:

Following the method presented in Reference 1, the hydrocarbon emissions from off-highway gasoline usage are based on 1000 gallons per gasoline-powered farm tractor, and 13 gallons per capita usage. The average emission factor for exhaust and crankcase hydrocarbons from tractor and non-tractor farm equipment is 156 $lb/10^3$ gal. The average emission factor for other off-highway equipment (e.g. lawnmowers, compressor engines, etc) is 485 $lb/10^3$ gal. Therefore, emissions for Davidson County are calculated as follows:

Number of tractors in County[18]	=	1,064
Assuming 60 percent of tractors gasoline-powered	=	638
Gasoline usage @ 1000 gal/tractor	=	638,000 gal
Farm equipment emissions	=	(156)(638)/(2000)
	=	49.8 ton/yr
Population of Davidson County[2]	=	449,600
Gasoline usage @ 13 gal per capita	=	5,844,800 gal
Per capita emissions	=	(485)(5,844.8)/(2000)
	=	1,417.4 ton/yr
Total emissions from off-highway gasoline usage	=	1,467.2 ton/yr

Diesel Usage:

Hydrocarbon emissions from off-highway diesel usage are based on 1000 gal per diesel-powered farm tractor, 7.4 gal per capita, and 5000 gal per non-building construction employee. The average emission factor for exhaust and crankcase hydrocarbons from tractor and non-tractor farm equipment is 58.6 $lb/10^3$ gal. The average emission factor for construction and other off-highway diesel usage is 30 $lb/10^3$ gal. Therefore, off-highway hydrocarbon emissions from diesel fuel usage in Davidson County would be calculated as follows:

Assuming 40 percent of tractors diesel powered	=	426
diesel usage @ 1000 gal/tractor	=	426,000 gal

Farm equipment emissions	=	(58.6)(426)/(2000)
	=	12.5 ton/yr

No. of non-building construction employees	=	2,899
Diesel usage @ 5000 gal/employee	=	14,495,000 gal
Population of Davidson County	=	449,600
Diesel usage @ 7.4 gal/capita	=	3,327,040 gal
Total usage	=	17,822,040 gal
Emissions from construction and other off-highway diesel usage	=	(30)(17,822)/(2000)
	=	267.3 ton/yr

Total emissions from off-highway diesel usage	=	279.8 ton/yr

Total emissions from off-highway gas and diesel usage	=	1,747.0 ton/yr

Total hydrocarbon emission from gasoline usage and diesel usage in the other six counties are shown in Table 4-5 and 4-6, respectively. It was assumed that all off-highway usage would occur during the spring, summer, and fall, and that negligible usage would occur in the winter. Therefore, the summer day emissions are equal to the total emissions divided by the total number of days of spring, summer, and fall (275), and multiplying by 2000 to convert to pounds.

Subcounty Distribution

The calculation of hydrocarbon emissions from this category is based almost entirely on population. The allocation of emissions to each grid in Davidson County were, therefore, distributed proportionately by the grid population.

Table 4-5. HYDROCARBON EMISSIONS FROM GASOLINE OFF-HIGHWAY USAGE*

County	Gasoline usage, 10^3 gal.		Emissions		
	Farm usage	Per capita usage	Annual, tons	Winter day, lbs.	Summer day, lbs.
Cheatham	444	209.3	85.4	Neg.	621.1
Davidson	638	5,844.8	1,467.2	Neg.	10,670.5
Robertson	1,881	410.8	246.3	Neg.	1,791.3
Rutherford	1,205	868.4	304.6	Neg.	2,215.3
Sumner	1,704	889.2	348.5	Neg.	2,534.5
Williamson	1,205	562.9	230.5	Neg.	1,676.4
Wilson	1,170	559.0	226.8	Neg.	1,649.5

* 1974.

Table 4-6. HYDROCARBON EMISSIONS FROM DIESEL OFF-HIGHWAY USAGE*

County	Diesel fuel usage, 10^3 gal.		Emissions		
	Farm usage	Construction and other usage	Annual, tons	Winter day, lbs.	Summer day, lbs.
Cheatham	296	344.1	13.8	Neg.	100.4
Davidson	426	17,822.0	279.8	Neg.	2,034.9
Robertson	1,254	548.8	45.0	Neg.	327.3
Rutherford	804	1,269.3	42.6	Neg.	309.8
Sumner	1,136	726.2	44.2	Neg.	321.5
Williamson	804	2,955.4	67.9	Neg.	493.8
Wilson	780	448.2	29.6	Neg.	215.3

* 1974.

4.3 RAIL LOCOMOTIVE

County-wide Emissions

Emissions as a result of railroad activity in Davidson County were computed from the state railroad fuel usage.[4]

Total state fuel oil (mainly distillate) usage by railroad = 2,215,000 bbl x 42

= 93.03×10^6 gal/yr

This quantity was then apportioned to the county by railroad track mileage:[15]

Total state railroad mileage = 5,791

Total county fuel oil usage by railroad = $(93,030,000)(\frac{406}{5,791})$

6,522,000 gal/yr

Contact with the Louisville and Nashville Railroad[16] indicated that approximately 24 million gallons of diesel oil are taken on by the trains in Davidson County per year. Nashville is a major refueling area in the state and it is to be expected that this value would be much higher than the actual county railroad fuel consumption. For this reason, the computed county fuel usage was assumed valid and was used in the emission determination.

An average locomotive emission factor of 94 lb/10^3 gal, when applied to the above fuel consumption, results in total particulate emissions for this category of 307 ton/yr.

By similar calculations, emissions from railroad activity in the other six counties are shown in Table 4-7. Railroad activity was assumed to be constant throughout the year. Therefore, daily winter and summer emissions will be equal.

Subcounty Distribution

The miles of railroad track in each grid were measured from USGS topographic maps of Davidson County. The total measured mileage was 317. Since the county contains 406 miles of railroad track,[15] the difference was added to grids where major track or yard facilities were noted. This was allocated proportionately to the measured track mileage and more heavily weighted the grids containing greater railroad activity, such as Radnor Yards. Switch engine activity (10-12 switch jobs/day) in the yards was assumed to be included in the emissions allotted to the grids with yard activity since yard emissions amounted to 42 percent of the total emissions from railroad activity in the county. The total hydrocarbon emissions from this category were then distributed to each grid on the basis of track mileage in the grid.

4.4 AIRCRAFT

County-wide Emissions

The effect of aircraft upon air quality is limited to the two airports of significant size in Davidson County. The number of operations by type of craft were obtained by direct contact with the airport authorities.[23] Data in Table 4-8 were used in computing the emissions from this category. Emission totals were computed by airport since allocation of emissions to grids are made on this basis.

Table 4-7. HYDROCARBON EMISSIONS FROM RAILROAD ACTIVITY*

County	Track mileage	Fuel oil usage 10^3 gal/yr	Emissions		
			Annual, tons	Winter day, lbs.	Summer day, lbs.
Cheatham	32	514	24	131.5	131.5
Davidson	406	6,522	307	1,682.2	1,682.2
Robertson	33	530	25	137.0	137.0
Rutherford	44	707	33	180.8	180.8
Sumner	74	1,189	56	306.8	306.8
Williamson	56	900	42	230.1	230.1
Wilson	41	659	31	169.9	169.9
State	5,791	93,030	4,372	23,956	23,956

* 1974.

Table 4-8. DAVIDSON COUNTY AIRPORT OPERATIONS DATA, 1974

Aircraft category	No. of engines	Emission factor* lb/engine/LTO	Berry Field		Cornelia Fort	
			LTO cycles	Emissions, ton/yr	LTO cycles	Emissions, ton/yr
Air carrier	2.44**	2.45	27,352	81.8		
Air taxi -						
Turboprop	2	1.45	2,711.5	3.9		
General aviation	1	0.40	46,555	9.3	20,000	4
	2	0.40	11,638.5	4.7	5,000	2
Military -						
Piston	2	10.20	2,632	26.8		
Transport	4	1.35	801	2.2		
Totals			91,690	128.7	25,000	6

* Emission factors for each class of aircraft are based upon LTO operations by mode (e.g. taxi-idle, take-off). For the air carrier, air taxi, and military classifications, the times in taxi-idle modes at the Metropolitan Nashville Airport (Berry Field) are much less than those on which the emission factors in AP-42 are based (10 minutes versus 26 minutes per LTO - Ref. 23), resulting in total operating times and emissions half those in AP-42.

** Average number of engines for all airplanes in this category (medium range jets) using Berry Field.

Cornelia Fort Airport: 50,000 general aviation operations
20 percent are 2 engine = 10,000 operations = 5,000 LTO
80 percent are 1 engine = 40,000 operations = 20,000 LTO
Applying an emission factor of 0.40 lb/engine/LTO
(5000)(2)(.40) = 4,000 lb/yr
(20000)(1)(.40) = 8,000 lb/yr

Total hydrocarbon emission equal 6 ton/yr.

Metropolitan Nashville Airport (Berry Field):

Air carriers:	(27,352)(2.44)(2.45)/2000 =	81.8 ton/yr
Air taxis:	(2,711.5)(2)(1.45)/2000 =	3.9
Generation aviation:	(46,555)(1)(0.40)/2000 =	9.3
	(11,638.5)(2)(0.40)/2000 =	4.7
Military:	(2,632)(2)(10.2)/2000 =	26.8
	(801)(4)(1.35)/2000 =	2.2
Total hydrocarbon emissions		=128.7 ton/yr

LTO data for the remaining six counties was obtained from Reference 11. Emissions from airport activity in all counties are shown in Table 4-9. Airport operations are assumed to be constant year round. Thus, winter and summer emissions will be equal.

Subcounty Distribution

Aircraft are considered area sources and the emissions from them are applied to the grids at the airport locations in Davidson County. The emissions from aircraft at Cornelia Fort have been applied to grids 27 and 36. The emissions from aircraft using the Metropolitan Nashville Airport were split as follows: 90 percent to grid 53a and 10 percent to grid 64.

Table 4-9. HYDROCARBON EMISSIONS FROM AIRCRAFT ACTIVITY*

Airfield	Emissions		
	Annual, tons	Winter day, lbs.	Summer day, lbs.
Davidson County			
Berry Field	128.7	705.2	705.2
Cornelia Fort	6.0	32.9	32.9
Total	134.7	738.1	738.1
Rutherford County			
Murfreesboro	8.8	48.2	48.2
Smyrna	16.1	88.2	88.2
Total	24.9	136.4	136.4
Sumner County			
Gallatin	17.6	96.4	96.4
Portland	2.2	12.1	12.1
Total	19.8	108.5	108.5
Wilson County			
Lebanon	4.2	23.0	23.0
Total	4.2	23.0	23.0

* 1974.

4.5 VESSELS

County-wide Emissions

To determine the contribution that vessel emissions make to the air quality of Davidson County, the in-port fuel consumption and underway fuel consumption must be obtained.

In-port fuel consumption:

Total diesel vessels in-port[13]	=	1,279 in 1973
Average time in-port[13]	=	12 hours
Therefore, vessel days in-port	=	$(\frac{12}{24})$ 1,279 = 639.5
Distillate (no residual fuel used[4]) fuel oil (diesel) consumption rate	=	660 gal/day
Total in-port vessel fuel consumption	=	(639.5)(660) = 422,000 gal/yr.

Applying the average emission factor for commercial motorships on rivers of 50 lb/10^3 gal of oil, in-port hydrocarbon emissions total 10.6 ton/yr.

Underway fuel consumption:

Nearly all vessel traffic in Davidson County passes through the Cheatham Lock and Dam and proceeds only as far as down-

town Nashville before turning around and leaving the county. Total miles of Cumberland River in the county is 57, with 27 miles to downtown Nashville from the Nashville/Cheatham County border.

Total number of diesel vessels = 1,279 inbound, 1,279 outbound

Total vessel miles = (1,279 + 1,279)27 = 69,066 mi/yr

Average motorship mileage factor[1] = 19 gal/nautical mile

Total underway vessel fuel consumption = $(69{,}066 \text{ ves.-mi})\left(\frac{1 \text{ naut. mi}}{1.1516 \text{ mi}}\right)\left(\frac{19 \text{ gal}}{\text{naut. mi}}\right)$

= 1,139,500 gal/yr

Applying the average emission factor for commercial motorships on rivers of 50 lb/10^3 gal of oil, underway hydrocarbon emissions total 28.5 ton/yr.

A preliminary calculation was made to determine the emissions from gasoline powered vessels. By surveying the marinas on the major inland water areas, and applying average emission factors, total emissions amounted to less than 1 ton/yr. The contribution from this category was, therefore, considered to be negligible.

Total hydrocarbon emissions from the vessel category in Davidson County are 39.1 ton/yr.

Vessel emissions are assumed to be constant throughout the year. Therefore, winter and summer daily emissions will be equal to 214.2 lbs.

Within the study area, vessel traffic on the Cumberland River passes only through Cheatham County, a distance of 23 miles with no ports along the way.

Total vessel miles = $(1,279 + 1,279)23 = 58,834$ mi/yr

Total underway vessel = $(58,834 \text{ ves.-mi})\left(\frac{1 \text{ naut. mi}}{1.1516 \text{ mi}}\right)\left(\frac{19 \text{ gal}}{\text{naut.mi}}\right)$

= 970,689 gal/yr

Applying the emission factor of 58 lb/10^3 gal, underway hydrocarbon emissions in Cheatham County total 24.3 ton/yr. The winter and summer daily emissions are equal to 133.2 lbs.

Subcounty Distribution

The vessel emissions in Davidson County are limited to the areas where the Cumberland River flows. For in-port vessel emissions, allocation was made to the inner city area only. For the underway vessel emissions, allocation was made to the grids containing the river on the basis of river miles in each grid. Only the 27 miles of river to downtown Nashville were used since the majority of the vessel traffic is on this sector.

5. INDUSTRIAL PROCESSES

County-wide Emissions

From the 1974 Tennessee Manufacturing Directory[27] a list was compiled of all companies who have the potential of emitting hydrocarbons to the atmosphere within the boundaries of the seven county study area. This list was cross-checked with source lists supplied by the Nashville-Davidson County Metropolitan Health Department and the Tennessee State Department of Air Pollution Control. Survey forms were sent to each company for which the county or state agencies had no information or for which available information required updating. These forms requested information regarding the manufacture or use of hydrocarbon-containing products such as paints, inks, cleaning solvents, etc. Usage figures were reported on these forms in gallons of product per year.

In Davidson County 328 survey forms were sent out and 65 percent of these forms were returned. Of this 65 percent, 55 percent reported the manufacture or use of hydrocarbon-containing materials. The Davidson County Agency did a follow-up survey of the 35 percent of the companies not returning the forms and found them to be either insignificant sources or no longer in business.[28]

It was not possible to categorize the hydrocarbon sources by process type since many companies did not indicate how any of these hydrocarbon-containing products were used. However, it is observed that many of these products can only be

used for certain types of processes: paint, shellac, lacquer, primer, etc., for surface coating; ink for printing; solvents for general degreasing and clean-up operations.

In developing emission factors for each product it was assumed that the volatile density of each product completely evaporated. The volatile density was determined by multiplying the average density of the product by its percentage volatile compound. These factors were obtained from the Air Pollution Engineering Manual, EPA publication AP-40,[29] and are shown in Table 5-1. The value for inks, shown in Table 5-1, was obtained through conversation with IPI Printing Inks.[30] The value for "gel-coat," a polyesther resin used in the manufacture of fiberglass boats, was obtained from the Alpha Chemical Company.[31]

The grid emissions from each source category were calculated by applying these emission factors to the respective total amounts of the products used in each grid. Total county emissions are the sum of the grid emissions.

An emission factor for dry cleaning solvents was calculated based on information contained in AP-42.[8] The emission factors for dry cleaning solvents are in terms of pounds of hydrocarbons emitted per ton of clothing dry cleaned. These are given as 305 lb/ton from an uncontrolled cleaner using petroleum solvents (Stoddard and 140°F), 210 lb/ton from an uncontrolled cleaner using synthetic solvents (perchloroethylene), and 95 lb/ton from a cleaner having average controls using synthetic solvents. Assuming 50 percent by weight of all clothing are cleaned with synthetic solvents,

Table 5-1. EMISSION FACTORS FOR

HYDROCARBON-CONTAINING PRODUCTS

Product	Average density[1] (lb/gal)	Average percent volatiles[1]	Emission factor (volatile density) (lb/gal)
Enamel	8.70	55.8	4.85
Primer	9.65	55.0	5.31
Varnish&Shellac	6.60	64.7	4.27
Lacquer	8.23	73.1	6.02
Stain&Glaze	7.55	68.4	5.16
Sealer	7.00	88.3	6.18
Thinner	6.60	100.0	6.60
Paint	12.50	56.0	7.00
Vinyl & polyurethane	8.33	79.2	6.60
Inks[2]	8.00	25.0	2.00
Gel-coat[2]	10.00	40.0	4.00
Gen. Sol.[3]	6.86	100.0	6.86

[1] Information obtained from AP-40

[2] Information obtained from personal communication with manufacturer.

[3] Information based on densities obtained from CRC Handbook of Chemistry and Physics and frequency of usage in Davidson County.

and 75 percent of all synthetic solvent operations have average controls, a weighted emission factor can be determined as follows:

petroleum solvents, uncontrolled = (305)(0.50) = 152.5

synthetic solvents, uncontrolled = (210)(0.125) = 35.6

synthetic solvents, average control = (95)(0.375) = 26.3

= 214.4 lb/ton

Also, assuming that in moderate climates each person dry cleans 18 pounds of clothes per year, the emission factor becomes (18 lb/capita-year)(214.4 lb/ton)(ton/2000 lb) = 1.93 lb/capita-year

Total emissions from dry cleaning in Nashville-Davidson County are therefore (449,600 population)(1.93 lb/capita-yr)(ton/2000 lb) = 434 tons/year

An emission factor for gasoline handling at service stations was also calculated from information contained in AP-42.[8]

Unloading tank trucks to underground storage at service station	= 7.3 lb/10^3 gal.
Filling motor vehicles, vapor displacement loss	= 11.0 lb/10^3 gal.
Liquid spillage loss	= 0.7 lb/10^3 gal.
Total hydrocarbon loss at service station	= 19.0 lb/10^3 gal.

This emission factor was applied to the total Davidson County gasoline sales of 237,565,429 gallons[26] to obtain a total of 2,257 tons/year of year of hydrocarbon emission from gasoline handling.

Annual emissions from petroleum products storage tanks were obtained from the county and state agencies.[32,25]

Total hydrocarbon emissions for each category in all seven counties are shown in Table 5-2. Emissions from these sources were assumed to be constant year round. Thus, winter and summer emissions will equal as shown in Table 5-3. Note that in the six exterior counties it was assumed that survey forms were returned by all significant industrial process hydrocarbon sources. However, no followup study was conducted to verify this assumption, and total emissions in these counties were determined from the survey forms which were returned from each.

Subcounty Distribution

Grid emissions from hydrocarbon-containing products in Nashville-Davidson county were calculated as described above. Emissions from dry cleaning operations were apportioned to grids by population. Hydrocarbon emissions from gasoline handling were apportioned to grids by the number of service stations located in each grid; and emissions from petroleum products storage tanks were allocated by the location of each storage tank. Emissions from each category by grid are given in Appendix E.

Table 5-2. INDUSTRIAL PROCESS HYDROCARBON EMISSIONS BY SOURCE CATEGORY IN TONS*

Source	County						
	Cheatham	Davidson	Robertson	Rutherford	Sumner	Williamson	Wilson
Paint		279.22		0.39	1.75	38.24	3.96
Primer		97.35		2.47	1.29	0.53	0.66
Enamel		145.51		135.80	1.21	7.15	13.27
Varn/Shel		13.57			0.40		
Lacquer		14.86		1.66			3.26
Sol.		203.83	0.15	139.40	0.75	12.89	32.11
Ink		461.16		3.34	0.25	0.02	
Gel-coat		36.64		17.45			
Stain		0.40			0.08		
Thinner		62.75				6.47	0.10
Sealer		0.79					
Dry Cl.	15.54	434.39	30.49	64.46	66.01	41.78	41.50
Sto. tanks		3310.0	7.7	20.3	19.9		19.5
Gas Sta.	8.2	2257.3	157.5	335.73	344.02	217.60	215.53
Misc.		32.35	0.26				
Total	23.74	7350.12	196.10	721.00	435.66	324.68	329.89

* 1974.

Table 5-3. INDUSTRIAL PROCESS HYDROCARBON EMISSIONS BY SEASON*

County	Annual tons	Winter day, lb.	Summer day, lb.
Cheatham	23.74	130.1	130.1
Davidson	7350.12	40274.6	40274.6
Robertson	196.10	1074.5	1074.5
Rutherford	721.00	3950.7	3950.7
Sumner	435.66	2387.2	2387.2
Williamson	324.68	1779.1	1779.1
Wilson	329.89	1807.6	1807.6

* 1974.

REFERENCES

1. Guide for Compiling Comprehensive Emission Inventory. U.S. Environmental Protection Agency. Publication No. APTD-1135. Research Triange Park, North Carolina. March, 1973.

2. Tennessee State Government - Local Planning Office. Population as of July 1, 1974.

3. Mineral Industry Surveys, "Bituminous Coal and Lignite Distribution, Calendar Year 1974." U.S. Department of the Interior, Bureau of Mines. Washington, D.C., 1975.

4. Mineral Industry Surveys, "Sales of Fuel-Oil and Kerosene: 1974." U.S. Department of the Interior, Bureau of Mines. Washington, D.C., 1975.

5. Mineral Industrial Surveys, "Natural Gas Production and Consumption: 1974." U.S. Department of the Interior, Bureau of Mines. Washington, D.C., 1975.

6. 1970 Census of Housing, "Detailed Housing Characteristics." HC-B series. U.S. Department of Commerce, Bureau of the Census. Washington, D.C., 1970.

7. Mineral Industry Surveys, "Sales of Liquified Petroleum Gases and Ethane: 1974," U.S. Department of the Interior, Bureau of Mines. Washington, D.C., 1975.

8. Compilation of Air Pollutant Emission Factors. U.S. Environmental Protection Agency. Publication AP-42, second edition, March 1975.

9. Supplement 5 AP-42. U.S. Environmental Protection Agency. April, 1975.

10. County Business Patterns. U.S. Department of Commerce, Bureau of the Census. Washington, D.C., 1972.

REFERENCES (continued)

11. Personal Communication: Mr. Dave Fulton, Tennessee Bureau of Aeronautics and Robert Livingston, PEDCo-Environmental, September 10, 1975.

12. County and City Data Book. U.S. Department of Commerce, Bureau of the Census. Washington, D.C., 1967.

13. Personal Communication: Mr. Jim Harper, Corps of Engineers - Nashville Division and Dan Matthews, PEDCo-Environmental Specialists, Inc., January 15, 1975.

14. Local Climatological Data. Annual Summary with Comparative Data, Nashville, Tennessee. U.S. Department of Commerce, National Oceanic and Atmospheric Administration Environmental Data Service, 1974.

15. Tennessee Public Service Commission, Tennessee State Railroad Administration Office. August, 1975.

16. Personal Communication: Mr. J. W. Webb, Louisville and Nashville Railroad and Dan Matthews, PEDCo-Environmental, February 28, 1975.

17. Particulate Area Source Emission Inventory for Nashville - Davidson County, Tennessee. PEDCo-Environmental, February 1975.

18. Census of Agriculture, County Data. U.S. Department of Commerce, Bureau of the Census. Washington, D.C., 1969.

19. Personal Communication: Dr. Walter Hough, U.S. Forest Service, Southern Forest Fire Laboratory and Robert Livingston PEDCo-Environmental, September 4, 1975.

20. Personal Communication: Mr. Fred Cassetty, Alley-Cassetty Coal Company and Dan Matthews, PEDCo-Environmental, January 9, 1975.

21. Nashville-Davidson County Air Pollution Control Division Files. February, 1975.

22. Personal Communication: Mr. W. Ray Calp, Nashville Gas Company and Dan Matthews, PEDCo-Environmental, January 9, 1975.

REFERENCES (continued)

23. Personal Communication: Mr. Dan Matthews, PEDCo-Environmental and Mr. John Fisher, Metropolitan Nashville Airport Authority; Mr. Colbert, Cornelia Fort Airport; and Captain Doe, Tennessee Air National Guard (Berry Field) on January 9, 1975.

24. Personal Commun tion: Mr. Larry Johnson, Tennessee Department of Transportation and Robert Livingston, PEDCo-Environmental, July-August, 1975.

25. Tennessee State Government - Division of Air Pollution Control files. September 1975.

26. Personal Communication: Mr. Peoples, Tennessee State Department of Revenue, Petroleum Tax Division, and Mr. Robert Livingston PEDCo-Environmental, August 8, 1975.

27. 1975 Tennessee Manufacturers Directory. Tennessee Department of Economic and Community Development. Nashville, Tenn.

28. Personal Communication: Mr. Paul Bontrager, Director, Pollution Control Division and Robert Livingston, PEDCo-Environmental, April 1976.

29. Air Pollution Engineering Manual, Second Edition, AP-40. Environmental Protection Agency, Research Triangle Park, North Carolina. May, 1973.

30. Personal Communication: Mr. James Allen, IPI Printing Inks, Division of Inmont Corporation, Cincinnati, Ohio and Robert Livingston, PEDCo-Environmental, April 7, 1976.

31. Alpha Chemical Co., Colliersville, Tennessee, April 7, 1976.

32. Nashville Davidson County Air Pollution Control Division Files. September, 1975.

33. Polk, R.L. and Company, Motor Statistical Division. Detroit, Michigan. 1975.

23. Personal Communication: Mr. Dan Matthews, PEDCo-Environmental and Mr. John Fisher, Metropolitan Nashville Airport Authority; Mr. Colbert, Cornelia Fort Airport; and Captain Doe, Tennessee Air National Guard (Berry Field) on January 9, 197 .

24. Personal Communication: Mr. Larry Johnson, Tennessee Department of Transportation and Robert Livingston, PEDCo-Environmental, July-August, 1975.

25. Tennessee State Government - Division of Air Pollution Control files. September 1975.

26. Personal Communication: Mr. Peoples, Tennessee State Department of Revenue, Petroleum Tax Division, and Mr. Robert Livingston PEDCo-Environmental, August 8, 1975.

27. 1975 Tennessee Manufacturers Directory. Tennessee Department of Economic and Community Development. Nashville, Tenn.

28. Personal Communication: Mr. Paul Bontrager, Director, Pollution Control Division and Robert Livingston, PEDCo-Environmental, April 1976.

29. Air Pollution Engineering Manual, Second Edition, AP-40. Environmental Protection Agency, Research Triangle Park, North Carolina. May, 1973.

30. Personal Communication: Mr. James Allen, IPI Printing Inks, Division of Inmont Corporation, Cincinnati, Ohio and Robert Livingston, PEDCo-Environmental, April 7, 1976.

31. Alpha Chemical Co., Colliersville, Tennessee, April 7, 1976.

32. Nashville Davidson County Air Pollution Control Division Files. September, 1975.

33. Polk, R.L. and Company, Motor Statistical Division. Detroit, Michigan. 1975.

APPENDIX A

1974 DAVIDSON COUNTY AREA SOURCE HYDROCARBON EMISSIONS BY SOURCE CATEGORY AND GRID

EMISSIONS BY SOURCE CATEGORY (tons/year)

Grid number	Bitumi-nous coal	Distil-late oil	Residual oil	Natural gas	Other fuels	Incin-eration	Open burning	Highway vehicles	Off-highway	Rail-road	Air-craft	Vessels	Industrial processes	Total
1a							0.7	196.8	3.3				0.8	201.6
3							0.2	187.9	3.3	1.5			0.8	193.7
4				0.1	0.5		0.3	187.9	5.8				1.4	196.0
5		0.4		0.4	1.4		1.0	223.0	16.1				16.0	258.3
6		1.2	0.3	2.9	4.7		0.5	233.0	53.6	8.3			146.0	460.5
7a			0.1	0.7		0.2		44.1						45.1
8a		0.6	0.1	0.9	0.1	0.1	0.1	965.1	50.5	2.3			40.6	1080.4
10a		0.9	0.2	1.8	0.1	0.7	0.1	965.1	54.0	5.3			155.4	2186.0
12		0.1		0.1	0.3		0.3	200.8	2.3				0.8	285.7
13		0.1	0.1	0.2	0.5		0.1	200.8	5.6				1.4	289.0
18a	16.0	2.8	0.3	3.8	3.0	0.3	0.7	1648.3	124.0	9.8			170.6	1979.6
20a		0.1	0.1	0.7	0.1		0.1	1316.9	55.2		1.9		56.2	1431.3
22				0.8	0.7		0.1	246.4	8.2	4.5		5.6	102.3	368.6
23		0.5	0.2	1.6			0.2	411.7	19.6	2.3		1.5	18.9	456.5
24	11.4		0.1	1.1	2.1	0.1	0.2	411.7	55.4	0.8		3.2	98.6	584.7
29		1.6	0.1	2.4	0.2	0.1	0.1	250.3	70.9	10.0			87.6	423.2
32a	17.0	1.6	0.4	4.0	3.2	0.2	1.0	1314.7	81.1	9.8		4.6	1651.4	3089.0
34a	74.9	4.2	0.4	5.7	13.7	0.9	2.5	1860.2	192.3	43.3		7.2	1591.4	3786.7
36a	59.9	3.4	0.4	6.1	11.0	0.4	2.2	1840.2	103.7	33.1		7.7	1353.4	3441.5
44a		0.4	0.2	1.7	0.1	0.2	0.2	1314.9	68.2	6.0	1.9		148.2	1544.0
48a	20.8	1.3	0.1	1.6	0.2	0.1	0.7	1101.1	70.9	4.5			12.1	1262.5
50a		2.9	0.2	3.0	3.9	0.2	2.2	1316.9	142.4	5.3			273.8	1791.6
52a		1.7	0.4	4.8	0.2	0.4	1.3	1482.6	95.7	44.5			318.9	1950.5
54a		1.1	0.2	2.0	0.1		0.7	1126.9	51.2	5.3	117.7		280.2	1685.4
56								44.1	0.7	1.5			0.2	46.5
		0.6	0.2	1.5	2.2		1.2	260.8	26.8			9.3	6.5	329.1

APPENDIX A (continued)

1974 DAVIDSON COUNTY AREA SOURCE HYDROCARBON EMISSIONS BY SOURCE CATEGORY AND GRID

EMISSIONS BY SOURCE CATEGORY (tons/year)

Grid number	Bitumi-nous coal	Distil-late oil	Residual oil	Natural gas	Other fuels	Incin-eration	Open burning	Highway vehicles	Off-highway	Rail-road	Air-craft	Vessels	Industrial processes	Total
64		1.4	0.2	2.2	0.1		0.1	280.8	62.4	4.5	13.2		134.5	497.4
65					0.1		0.2	146.4	2.8				0.7	150.2
66a		1.0	0.1	1.9	0.2	0.1	0.3	944.7	74.8	80.2			413.5	1316.8
66a		1.0	0.2	2.1	0.1	0.2	0.1	944.7	44.0	6.0			103.5	1101.9
70		0.7	0.1	0.8	0.1	0.1	0.3	260.4	30.0	2.3			92.7	387.5
71				0.4	0.1	0.2	0.3	260.4	30.7				121.0	413.1
76							0.1	44.1	2.8				0.7	47.7
77					0.4		0.3	223.0	4.2	1.5			1.0	230.4
78		0.7	0.2	1.7	2.7		0.4	223.0	30.5	6.8			7.4	273.4
79					0.4		0.1	191.5	4.9				1.2	198.1
80		0.1		0.1	0.5			191.5	5.6	1.5			1.3	200.6
81				0.2	1.7		0.1	191.5	20.3	1.5			4.9	220.2
82		0.2	0.1	2.2	0.8	0.1	0.2	223.0	9.1	0.8			30.6	267.0
83		0.8	0.3		2.9		0.4	223.0	34.0	3.8			8.6	273.8
84								44.1	0.7				1.2	46.0
85							0.1	223.0	2.8				0.7	226.6
86				0.1	0.5		0.1	149.9	5.6				1.4	157.6
Total	200.0	21.4	5.3	59.6	58.9	4.0	19.7	24,399.2	1,747.0	307.0	134.7	39.1	7,350.1	34356.0

APPENDIX B

LIST OF INCINERATORS IN NASHVILLE-DAVIDSON COUNTY (January, 1975)

	Grid No.	Capacity, #/hr.	Est. refuse Burnt, #/day
American Bread Company, 702 Murfreesboro Road	51	50	65
Bill Crook's Food Town, 309 Main Street	34		50
Bill Crook's Food Town, No. 2, 1439 Robinson Road	29	250	20
Bill Martin's Food Town, 211 11th Avenue South	41	190	100
Bi-Rite Foods, 601 Armory Drive	66	520	50
Big Star, No. 214, 4702 Gallatin Road	19	260	150
Blackstone Apartments, 3300 West End Avenue	48		100
Cain Sload Company, Riverdale	36	800	200
Castner-Knott, 2731 Donelson Plaza	45	500	15
Compton's Bi-Rite, Old Hickory Boulevard	29		150
Compton's Food Town, 21st and Blair	49		150
Cooper & Martin, 5412 Charlotte Avenue	39	500	160
Cooper & Martin, No. 18, 1154 Gallatin Road	35		400
Cooper & Martin, No. 1, 2500 Gallatin Road	26		500
Cooper & Martin, No. 13, 2421 Lebanon Road	44		150
Cooper & Martin, No. 21, 1364 Murfreesboro Road	52		45
Cooper & Martin, No. 15, 2935 Nolensville Road	61		100
Crump Carving Company, 2021 Fittway Drive*	26		100
Donelson Hospital, 3055 Lebanon Road, Path.	45		15
Farmers Market Store, 715 Jefferson Street	33	450	225
Federal Reserve Bank, 301 8th Avenue North	41	700	600
Food Town Stones River, 3208 Lebanon Road	64	600	100
Giant Foods, 100 Oaks	71	800	200

APPENDIX B (continued).

LIST OF INCINERATORS IN NASHVILLE-DAVIDSON COUNTY (January, 1975)

	Grid No.	Capacity, #/hr	Est. refuse burnt, #/day
Giant Foods, 100 Oaks	71	800	200
Giant Foods, Grant Plaza, (Old Hickory & Gallatin)	10	400	200
Giant Foods, Grant Plaza, (Old Hickory & Gallatin)	10	800	200
Green Hills Market, 3909 Hillsboro Road	71	100	100
Grant, W.T. Co., Grants Plaza, (Old Hickory & Gallatin)	10	800	100
Harvey's, 518 Church Street	42	500	400
Hill, H.G. Co., Sidco Drive	66	750	100
Jemima Nooe Home, 3712 Richland Avenue, Path.	-		
Jerry's Bi-Rite, 921 North First Street	34	250	350
Joelton Food Town, 7111 Whites Creek Pike	5		150
Kent's Dollar Store, Nolensville Road	82	375	150
Kent's Dollar Store, 2618 Gallatin Road	26	400	150
Kroger Company, Elm Hill Pike	-	33	1
Madison Hospital, Sanitarium Road, Path.	17		20
Malone's Market, 4000 Gallatin Road	26	300	150
Malone & Hyde, 407 Craighead	50	800	800
Malone & Hyde, Powell Avenue	7		840
Maplewood Food Town, Gallatin Road	20	250	150
Mason Brandon Industries, Charlotte Avenue*	40		250
Metro Bordeaux Hospital, County Hospital Road	31	600	300
Metro Dog Pound, County Hospital Road, Path.*	31		1,000
Metro General Hospital, 72 Hermitage Avenue	42	500	10
Middle Tennessee Chest, Disease Hospital, Ben Allen Road	19	500	350
Miller's Clinic, 602 Gallatin Road, Path.	-		
Moore's Big Star, 3000 Lebanon Road	45	300	400

APPENDIX B (continued).

LIST OF INCINERATORS IN NASHVILLE-DAVIDSON COUNTY (January, 1975)

	Grid No.	Capacity #/hr	Est. refuse burnt, #/day
Murphy Bi-Rite, 3636 Murphy Road	48	36	200
Nashville Memorial Hospital, 612 West Due West, Path.	15		30
North Town Big Star, No. 612, 2501 Clarsville Highway	30	240	150
Park View Hospital, 230 25th Avenue North, Path.	40		20
Sealtest Foods, 1401 Church Street*	41	300	700
Seven-Eleven Super Saver, 525 Meridian Street	34	250	50
Sky Chef, Berry Field	63	500	18
St. Thomas Hospital, Harding Road	-		
Sunflower, Highway 100 at Highway 70	70	500	200
Tennessee St. Army Nat. Guard, 3041 Sidco Drive	66	100	15
Tennessee St. Air Nat. Guard, Berry Field	63	100	10
Tennessee State University, Centennial Boulevard, Path.	32		2
Thompson's Food Town, 4717 Nolensville Road	74	250	300
Townley's Big Star, 4486 Nolensville Road	74	500	500
Vanderbilt Hospital, Davidson Road	56	400	400
Veterans Adm. Hospital, 1310 24th Avenue, So., Path.	49		10
Veterans Adm. Hospital, 1310 24th Avenue, So.	49	1,000	350
Webb's Bi-Rite, 2817 Dickerson Road	25	250	100
Westgate Food Town, 6035 Highway 100	70	355	200
West Side Hospital, 2208 Patterson, Path.	41		75
Winn Dixie Store, Dickerson Plaza	14	200	100
Woolco Department Store, 100 Oaks	71		150
Woolco Department Store, Dickerson Plaza	14	1,000	200
Woolworth Co., F.W., 820 Madison Square	10		150

* Industrial establishments (all others commercial-institutional).

APPENDIX C

1974 HIGHWAY VEHICLE EMISSIONS BY COUNTY, VEHICLE TYPE, ROAD TYPE, AND SEASON

The following tables show the emission factors and emissions calculated as described in Section 4 for each combination of county, vehicle type, road type and season. The headings have the following interpretation:

CO, County Names:
- CHT, Cheatham
- DAV, Davidson
- ROB, Robertson
- RTH, Rutherford
- SMN, Sumner
- WMS, Williamson
- WIL, Wilson

V, Vehicle type:
- CAR, Automobile
- LDT, Light-duty gasoline-powered truck
- HDG, Heavy-duty gasoline-powered truck
- HDD, Heavy-duty diesel-powered truck

R, Road type:
- F, Freeway
- A, Arterial
- L, Local

A, Area Classification:
- CBD, Central Business District
- CC, Central City
- SUB, Suburban

VMT, Total daily vehicle miles traveled in that county, on that road type, in that area.

VPCT, Percentage of that VMT traveled by that vehicle type

DMAVT, Product of VMT and VPCT

WIN, Emission factor for a typical winter day in /mile

DWE, Typical winter day emissions in pounds

AWE, Winter season (90 days) emissions in tons

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SPF, emission factor for a typical spring or fall day in grams/mile

DSFE, Typical spring or fall day emissions in pounds

ASFE, Spring and fall season (183 days combined) emissions in tons

SUM, Emission factor for a typical summer day in grams/mile

DSE, Typical summer day emissions in pounds

ASE, Summer season (92 days) emissions in tons

TAE, Total annual emissions in tons, sum of AWE, ASFE, and ASE.

APPENDIX C

1974 HIGHWAY VEHICLE EMISSIONS BY COUNTY, VEHICLE TYPE, ROAD TYPE, AND SEASON

CO	S	H	A	VMT	SPCT	DYVMT	HC	CAE	AAE	SPE	DSPE	ASPE	SUM	USE	ASE	YAE
CMT	CAR	F	SUM	31555.	0.0839	2649.	0.490	306.9	13.0	5.903	279.1	27.5	5.352	293.0	11.0	50.9
CMT	CAR	A	SUM	1015?0.	0.0839	11?508.	7.232	1?62.3	79.3	6.?30	1593.2	1?5.7	6.?85	1?69.0	85.9	291.0
CMT	CAR	L	SUM	91392.	0.0835	8259.	9.797	1350.4	80.7	8.731	1208.4	110.1	7.727	1?85.1	95.9	219.8
CMT	LDT	F	SUM	31555.	0.2?17	7579.	9.?22	157.4	7.0	8.630	144.2	13.1	7.685	131.7	6.0	26.3
CMT	LDT	A	SUM	1015?0.	0.2?17	3?05?0.	1?.?03	695.9	?0.3	?.?09	615.5	?4.6	8.590	739.7	34.0	1?8.9
CMT	LDT	L	SUM	91392.	0.2?17	2?5?92.	13.?13	973.6	36.9	11.?01	809.1	55.2	11.?54	938.??	2?.7	110.3
CMT	HDG	F	SUM	3155?.	0.?369	11?49.	1?.?42	?0.?	1.8	19.822	?0.?	3.7	19.842	?0.?	1.8	7.3
CMT	HDG	A	SUM	1015?0.	0.?369	3?72?.	1?.133	2?1.8	10.7	1?.133	2?1.8	?1.8	1?.133	2?1.8	10.9	?3.5
CMT	HDG	L	SUM	91392.	0.?369	33?6?.	25.?4?	191.8	8.8	25.?48	191.8	17.5	25.?48	191.8	8.8	35.8
CMT	HDD	F	SUM	31555.	0.0373	1177.?	?.3?1	0.0	0.2	?.3?1	0.0	0.5	?.3?1	0.0	0.2	1.1
CMT	HDD	A	SUM	1015?0.	0.0373	3?82?.	?.?09	39.?	1.?	?.?09	39.?	3.6	?.?09	39.?	1.8	7.2
CMT	HDD	L	SUM	91392.	0.0373	3412.	?.?09	32.0	1.?	?.?09	32.0	2.9	?.?09	32.0	1.?	5.8

APPENDIX C (continued).

1974 HIGHWAY VEHICLE EMISSIONS BY COUNTY, VEHICLE TYPE, ROAD TYPE, AND SEASON

CO	*	M	A	VMT	VPCT	LPAST	PCT	LPE	ADL	SPF	DSPE	ASPE	SUM	DSE	ASE	TAL
DA	CAR	F	SUM	12753e1.	0.0070	103cc7e.	e.250	13969.0	6.6.0	5.596	12710.5	11e3.0	5.074	11540.0	530.1	2321.8
DA	CAR	A	SUM	225e710.	0.0070	1821041.	e.450	27918.6	1137.0	6.195	29875.6	227e.1	5.577	22397.4	1030.2	4544.2
DA	CAR	L	SUM	437e61.	0.0070	353e01.	7.1 09	7423.2	3e5.0	6.2e2	8438.0	5e9.1	7.315	57.0.5	2e2.2	1170.4
DA	CAR	F	CC	11Ae1e7.	0.0070	9be47e.	e.150	12990.5	56e.7	5.596	12705.8	1e7e.2	5.07e	10600.0	491.5	2152.5
DA	CAR	A	CC	1e2e7e5.	0.0070	13.1e55.	e.17e	23e39.8	1000.7	7.327	2.188.1	1938.7	e.5e9	18e02.6	8e0.5	3e71.0
DA	CAR	L	CC	8e3e0e.	0.0070	5e33e7.	10.61e	12e75.2	5e1.3	9.5e0	11e55.5	1011.5	e.422	9719.4	4e7.0	2020.0
DA	CAR	F	CBD	515e6e.	0.0070	41e821.	e.14e	5e42.1	2e3.8	5.592	5134.0	4e9.7	5.071	4e55.7	21e.1	937.8
DA	CAR	A	CBD	2Ae521.	0.0070	22e5e5.	7.4e9	4e30.8	2e0.3	e.2e2	4127.9	377.7	7.315	3e34.e	1e0.1	75e.2
DA	CAR	L	CBD	51e61.	0.0070	4e8e3.	13.15e	1361.0	e4.1	11.75e	1215.e	111.2	10.e51	1e39.9	4e.7	24e.1
DA	LDT	F	SUM	127e891.	0.1151	14e903.	e.73e	2e30.0	127.3	e.017	2597.1	237.e	7.34e	2377.6	1e9.3	47e.3
DA	LDT	A	SUM	225e710.	0.1151	259705.	9.e30	5e15.0	2e0.1	e.7e1	5128.9	4e0.1	7.9e3	4571.5	21e.2	9e8.6
DA	LDT	L	SUM	437e61.	0.1151	50399.	14.79e	1431e.4	e3.7	11.445	1271.9	11e.3	10.72e	1135.6	5e.e	232.3
DA	LDT	F	CC	11Ae1e7.	0.1151	13e192.	e.73e	2e21.e	11e.0	e.e17	2e07.7	2ee.3	7.39e	22e7.5	1e1.7	43e.7
DA	LDT	A	CC	1e2e7e7.	0.1151	1e7e31.	14.33e	4e74.8	21e.3	10.239	4222.e	3ee.3	9.2e7	3797.4	17e.e	771.4
DA	LDT	L	CC	8e3e0e.	0.1151	74e39.	14.74e	2424.3	1e7.e	11.1e1	2162.e	197.9	11.67e	1946.7	8e.1	393.1
DA	LDT	F	CBD	515e6e.	0.1151	59373.	e.72e	1142.e	51.7	e.e1e	1e48.6	9e.9	7.33e	9e1.2	4e.1	191.5
DA	LDT	A	CBD	2Ae521.	0.1151	3e311.	7.74e	9e6.e	4e.e	11.4e5	e15.4	7e.e	10.22e	7e1.2	3e.7	14e.9
DA	LDT	L	CBD	51e61.	0.1151	6e87.	17.e85	e63.7	11.e	15.e39	233.5	e1.3	13.913	e.5.1	9.7	42.e

APPENDIX C (continued).

1974 HIGHWAY VEHICLE EMISSIONS BY COUNTY, VEHICLE TYPE, ROAD TYPE, AND SEASON

DA,	HDG	F	SUB	1275881.	0.0384	49028.	14.704	1989.5	71.5	14.704	1989.5	145.4	14.704	1989.5	73.1	290.0
DA,	HDG	A	SUB	2254714.	0.384	86667.	10.921	3233.8	140.5	10.921	3233.8	285.8	10.921	3233.8	148.7	590.1
DA,	HDG	L	SUB	447581.	0.0384	17219.	24.116	694.3	40.2	24.116	694.3	81.8	24.116	694.3	41.1	163.2
DA,	HDG	F	CC	1154947.	0.0384	44449.	14.704	1473.6	64.3	14.704	1473.6	130.8	14.704	1473.6	67.7	268.9
DA,	HDG	A	CC	1637749.	0.0384	62915.	20.853	2089.9	129.1	20.853	2089.9	262.5	20.853	2089.9	132.3	523.7
DA,	HDG	L	CC	647004.	0.0384	24906.	28.739	1576.4	71.3	28.739	1576.4	144.9	28.739	1576.4	72.6	288.0
DA,	HDG	F	CBD	513488.	0.0384	19813.	14.756	644.7	29.0	14.756	644.7	58.9	14.756	644.7	29.6	117.6
DA,	HDG	A	CBD	727421.	0.0384	27982.	24.116	973.3	25.8	24.116	973.3	52.4	24.116	973.3	26.3	104.6
DA,	HDG	L	CBD	58081.	0.0384	2231.	35.402	174.2	7.8	35.402	174.2	15.9	35.402	174.2	8.0	31.7
DA,	HDD	F	SUB	1275881.	0.0387	49378.	2.341	254.9	11.4	2.341	254.9	23.3	2.341	254.9	11.7	46.5
DA,	HDD	A	SUB	2254714.	0.387	87294.	2.709	571.5	25.7	2.709	571.5	52.2	2.469	571.5	26.2	104.3
DA,	HDD	L	SUB	447581.	0.0387	17340.	4.269	154.2	7.1	4.269	154.2	14.5	4.269	154.2	7.3	29.0
DA,	HDD	F	CC	1143397.	0.0387	44278.	2.341	236.3	10.6	2.341	236.3	21.6	2.341	236.3	10.8	43.1
DA,	HDD	A	CC	1621769.	0.0387	62798.	3.844	567.3	22.8	3.844	567.3	40.4	3.844	567.3	23.3	92.5
DA,	HDD	L	CC	640634.	0.0387	25006.	4.813	200.2	11.9	4.813	200.2	24.3	4.813	200.2	12.2	48.5
DA,	HDD	F	CBD	513488.	0.0387	19867.	2.451	107.8	4.8	2.451	107.8	9.8	2.451	107.8	4.9	19.6
DA,	HDD	A	CBD	288521.	0.0387	11160.	4.269	102.1	4.5	4.269	102.1	9.3	4.269	102.1	4.6	18.6
DA,	HDD	L	CBD	58081.	0.0387	2247.	5.453	27.0	1.2	5.453	27.0	2.4	5.453	27.0	1.2	4.9

APPENDIX C (continued).

1974 HIGHWAY VEHICLE EMISSIONS BY COUNTY, VEHICLE TYPE, ROAD TYPE, AND SEASON

CO	V	M	A	VMT	VMCT	VMAT	MIN	LDE	ADE	SPF	USPF	ASPE	SUM	USE	ASE	TAE
ADF	CAR	F	SUM	[illegible]	0.7122	[illegible]	0.569	651.2	48.4	0.940	574.1	52.5	5.365	[illegible]	43.9	104.8
ADU	CAR	A	SUM	317118.	0.7122	245874.	7.479	3625.4	103.1	0.581	3277.7	299.9	5.429	2930.9	135.7	590.7
ADF	CAR	L	SUM	179379.	0.7122	147765.	9.384	2774.1	103.0	0.791	2470.8	400.0	7.781	2192.2	140.8	452.5
ADH	LDT	F	SUM	[illegible]	0.0414	12497.	7.982	473.3	12.2	0.113	249.1	22.7	0.425	227.3	10.4	45.5
ADU	LDT	A	SUM	317118.	0.0414	83902.	11.011	1551.0	69.7	1.010	1410.1	149.0	9.068	1277.4	58.7	257.5
ADH	LDT	L	SUM	179379.	0.0414	36145.	14.668	1170.3	54.0	15.153	1.40.0	93.8	11.710	933.0	42.9	191.4
ADH	MCD	F	SUM	[illegible]	0.0429	2099.	10.086	97.2	4.3	10.080	97.2	8.8	10.[illegible]0	97.2	4.4	17.7
ADH	MCD	A	SUM	317118.	0.[illegible]29	13624.	19.059	572.5	25.7	19.059	572.5	52.3	19.059	572.5	26.3	104.4
ADH	MCD	L	SUM	179379.	0.[illegible]29	7710.	20.780	463.5	20.8	20.980	463.5	41.9	20.980	463.5	21.0	83.8
ADH	MCD	F	SUM	[illegible]	0.0433	2[illegible]0.	6.341	13.7	0.6	6.341	12.7	1.2	6.341	13.7	0.6	2.5
ADH	MCD	A	SUM	317118.	0.0433	13730.	6.969	69.9	3.0	6.969	69.9	6.2	6.969	69.9	3.1	12.4
ADF	MCD	L	SUM	179379.	0.0433	7771.	9.269	73.0	3.2	9.269	73.0	6.6	9.269	73.0	3.3	13.3

APPENDIX C (continued).

1974 HIGHWAY VEHICLE EMISSIONS BY COUNTY, VEHICLE TYPE, ROAD TYPE, AND SEASON

CO	V	R	A														
ATM	CAR	F	SUM	130[illegible].	0.7+11	1.[illegible]+7.	0.+78	1451.7	65.5	5.+95	1391.6	1[illegible].8	5.3+2	1197.2	56.1	2+1.2
ATM	CAR	A	SUM	6703[illegible].	0.7+11	5.1+7M.	7.+41	8134.3	370.2	0.529	7635.3	[illegible]19.8	1.+77	8[illegible].	3[illegible].1	1377.2
ATM	CAR	L	SUM	17[illegible].	0.7+11	2[illegible].	9.767	[illegible]3[illegible].8	207.8	0.722	5[illegible]7.3	5[illegible].2	7.7+9	51[illegible].	[illegible]31.9	1[illegible].9
ATM	LDT	F	SUM	1[illegible].	0.1+83	11214.	9.+40	+59.3	20.0	0.707	+[illegible]3.4	20.4	0.+03	3[illegible].7	17.0	70.7
ATM	LDT	A	SUM	6[illegible].	0.1+83	1[illegible]17.	1[illegible].651	2[illegible]5.0	117.7	9.8+6	2376.8	2.7.0	0.6+4	2[illegible]5.9	[illegible]9.1	[illegible]0.5
ATM	LDT	L	SUM	17[illegible].	0.1+83	[illegible]2[illegible].	24.+61	1[illegible]1.7	66.7	11.[illegible]	1[illegible].3	1[illegible].0	11.[illegible]	1[illegible]3.0	7[illegible].3	322.7
ATM	HDG	F	SUM	1[illegible].	0.1277	[illegible]7.	1[illegible].+41	1[illegible]1.1	0.7	1[illegible].+41	111.1	12.0	10.+41	111.1	0.1	23.9
ATM	HDG	A	SUM	67.[illegible].	0.1277	1.[illegible]9.	1[illegible].658	778.0	39.7	1[illegible].658	771.0	70.7	1[illegible].658	778.0	35.5	1+1.0
ATM	HDG	L	SUM	17[illegible].	0.1277	1[illegible]15.	2[illegible].7[illegible]	8[illegible].7	47.8	2[illegible].728	8[illegible].7	5[illegible].7	2[illegible].728	8[illegible].7	4[illegible].5	2[illegible].3
ATM	HDL	F	SUM	1[illegible].	0.2[illegible]	3[illegible].	4.3+1	1[illegible].6	0.0	4.3+1	15.8	1.7	2.+41	1[illegible].8	1.8	3.4
ATM	HDL	A	SUM	67.[illegible].	0.1[illegible]	1[illegible]7.	4.+97	1[illegible]4.7	5.5	4.[illegible]4	1[illegible]8.7	11.2	4.+69	1[illegible]6.9	5.8	24.4
ATM	HDL	L	SUM	17[illegible].	0.1[illegible]	1.[illegible]2.	9.+[illegible]	49.3	0.4	9.[illegible]	48.8	9.1	9.[illegible]	49.8	0.3	1[illegible].2

APPENDIX C (continued).

1974 HIGHWAY VEHICLE EMISSIONS BY COUNTY, VEHICLE TYPE, ROAD TYPE, AND SEASON

CO	V	R	S												
SM%	CAR	F	SUB	187210.	0.7788	145756.	6.120	1497.2	82.1	5.754	1310.6	140.4	5.217	1193.6	54.9	240.5
SM%	CAR	A	SUB	859421.	0.7788	669649.	7.409	6512.4	373.9	6.373	7513.5	667.4	5.737	6763.4	311.1	1372.5
SM%	CAR	L	SUB	1046791.	0.7788	815429.	7.349	8165.9	456.0	6.806	9078.5	817.1	7.530	8241.9	231.0	1630.6
SM%	LDT	F	SUB	118210.	0.1691	20034.	9.873	475.7	21.9	8.787	435.8	39.8	8.206	397.9	16.3	79.5
SM%	LDT	A	SUB	859421.	0.1691	145304.	10.578	2706.1	121.8	9.824	2408.3	225.9	8.728	2234.9	102.8	450.1
SM%	LDT	L	SUB	1046791.	0.1691	176933.	10.379	2038.1	93.7	12.619	1867.6	167.2	11.244	1625.6	74.9	333.9
SM%	HDG	F	SUB	118210.	0.0258	3048.	10.199	121.1	5.5	10.199	121.1	11.2	10.199	121.1	5.6	22.4
SM%	HDG	A	SUB	859421.	0.0258	17774.	10.542	726.6	32.8	10.542	726.6	66.9	10.542	726.6	33.4	132.6
SM%	HDG	L	SUB	1046791.	0.0258	21650.	20.309	583.1	26.2	20.309	583.1	53.8	20.309	583.1	26.8	106.9
SM%	HDG	F	SUB	118210.	0.0260	3069.	6.341	17.9	0.8	6.341	17.9	1.6	6.341	17.9	0.8	3.2
SM%	HDG	A	SUB	859421.	0.0260	17879.	6.369	117.0	5.2	6.969	117.0	10.7	6.969	117.0	5.3	21.3
SM%	HDG	L	SUB	1062752.	0.0260	22113.	9.264	95.0	4.2	9.264	95.0	8.7	9.264	95.0	4.3	17.3

APPENDIX C (continued).

1974 HIGHWAY VEHICLE EMISSIONS BY COUNTY, VEHICLE TYPE, ROAD TYPE, AND SEASON

[illegible]															
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APPENDIX C (continued).

1974 HIGHWAY VEHICLE EMISSIONS BY COUNTY, VEHICLE TYPE, ROAD TYPE, AND SEASON

CO	V	R	A	VMT	VKT	DVMT	VIN	VOL	AOL	SPF	USPL	ASPL	SUM	CSL	ASL	TAL
WIL	CAR	F	SUM	4[illegible].	0.7737	4.797.	0.010	481.0	41.6	0.920	447.0	77.5	5.374	767.9	35.3	154.7
WIL	CAR	A	SUM	6[illegible].	0.7737	3[illegible].	7.[illegible]2	5[illegible].6	2[illegible].5	0.565	4[illegible].0	44.2	1.510	4[illegible].2	2[illegible].1	8[illegible].3
WIL	CAR	L	SUM	2[illegible].	0.7737	1[illegible].	0.[illegible]7	9.[illegible].8	1[illegible].3	0.767	3[illegible].1	334.0	7.7[illegible]	3[illegible].7	1[illegible].0	8[illegible].1
WIL	LDT	F	SUM	4[illegible].	0.1752	1[illegible].	0.938	321.4	14.4	0.086	294.0	20.5	0.298	268.2	12.3	53.7
WIL	LDT	A	SUM	7[illegible].	0.1752	7[illegible].	1[illegible].[illegible]0	1[illegible]2.4	62.9	0.989	1[illegible]5.5	126.3	9.[illegible]6	15[illegible].4	69.3	304.2
WIL	LDT	L	SUM	2[illegible].	0.1752	9[illegible].	1[illegible].[illegible]0	1[illegible].	6[illegible].2	11.140	1[illegible]9.3	113.4	11.695	1[illegible]3.0	50.7	2[illegible].4
WIL	MCO	F	SUM	4[illegible].	0.[illegible]8	1[illegible].	1[illegible].[illegible]9	7[illegible].0	3.0	1[illegible].[illegible]9	7[illegible].0	7.1	1[illegible].[illegible]9	7[illegible].0	3.0	14.3
WIL	MCO	A	SUM	7[illegible].	0.[illegible]8	1[illegible].	1[illegible].[illegible]7	4[illegible].3	2[illegible].0	1[illegible].217	4[illegible].3	42.5	1[illegible].217	4[illegible].3	21.3	8[illegible].5
WIL	MCO	L	SUM	2[illegible].	0.[illegible]8	4[illegible].	2[illegible].[illegible]0	3[illegible].3	1[illegible].7	2[illegible].218	3[illegible].3	33.9	2[illegible].218	3[illegible].3	17.0	6[illegible].7
WIL	HDG	F	SUM	4[illegible].	0.[illegible]0	2[illegible].	4.[illegible]1	11.0	0.4	4.[illegible]1	11.0	1.0	4.[illegible]1	11.0	0.5	2.0
WIL	HDG	A	SUM	6[illegible].	0.[illegible]0	1[illegible].	4.[illegible]9	7[illegible].4	3.2	4.[illegible]9	72.4	6.0	4.[illegible]9	72.4	3.3	13.2
WIL	HDG	L	SUM	2[illegible].	0.[illegible]6	6[illegible].	9.[illegible]4	58.8	2.0	9.264	58.8	5.3	9.264	58.8	2.7	1[illegible].7

APPENDIX D.

1974 DAVIDSON COUNTY HIGHWAY VEHICLE EMISSIONS BY VEHICLE TYPE AND GRID

Grid number	Highway vehicle emissions (ton/year)				
			Heavy-duty trucks		
	Automobile	Light-duty trucks	gasoline-powered	diesel-powered	Total
1a	145.1	29.2	19.2	3.3	196.8
3	138.5	27.8	18.4	3.2	187.9
4	138.5	27.8	18.4	3.2	187.9
5	166.6	33.5	19.5	3.4	223.0
6	166.6	33.5	19.5	3.4	223.0
7a	32.6	6.5	4.3	0.7	44.1
8a	726.7	146.0	95.8	16.6	985.1
10a	726.7	146.0	95.8	16.6	985.1
12	207.2	41.6	27.3	4.7	280.8
13	207.2	41.6	27.3	4.7	280.8
18a	1215.5	244.0	161.2	27.6	1648.3
20a	971.2	195.1	128.6	22.0	1316.9
22	181.7	36.5	24.0	4.2	246.4
23	303.9	61.0	40.2	6.6	411.7
24	303.9	61.0	40.2	6.6	411.7
29	181.7	36.5	27.4	4.7	250.3
30a	956.3	192.1	144.8	21.5	1314.7
32a	1373.2	275.7	180.5	30.8	1860.2
34a	1373.2	275.7	180.5	30.8	1860.2
36a	971.2	195.1	128.6	22.0	1316.9
46a	849.0	170.5	112.2	19.4	1151.1
48a	971.2	195.1	128.6	22.0	1316.9
50a	1093.4	219.6	144.8	24.8	1482.6

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APPENDIX D (continued).

1974 DAVIDSON COUNTY HIGHWAY VEHICLE EMISSIONS BY VEHICLE TYPE AND GRID

Grid number	Highway vehicle emissions (ton/year)				
	Automobile	Light-duty trucks	Heavy-duty trucks		Total
			gasoline-powered	diesel-powered	
52a	833.9	167.4	106.6	19.0	1126.9
54a	32.6	6.5	4.3	0.7	44.1
55	207.2	41.6	27.3	4.7	280.8
64	207.2	41.6	27.3	4.7	280.8
65	108.2	21.1	12.8	4.3	146.4
66a	696.8	140.0	92.1	15.8	944.7
68a	696.8	140.0	92.1	15.8	944.7
70	192.2	38.5	25.4	4.3	260.4
71	192.2	38.5	25.4	4.3	260.4
76	32.6	6.5	4.3	0.7	44.1
77	166.6	33.5	19.5	3.4	223.0
78	166.6	33.5	19.5	3.4	223.0
79	141.1	28.4	18.8	3.2	191.5
80	141.1	28.4	18.8	3.2	191.5
81	141.1	28.4	18.8	3.2	191.5
82	166.6	33.5	19.5	3.4	223.0
83	166.6	33.5	19.5	3.4	223.0
84	32.6	6.5	4.3	0.7	44.1
85	166.6	33.5	19.5	3.4	223.0
86	110.3	22.1	14.9	2.6	149.9
Total	18000.0	3614.4	2377.8	407.0	24399.2

APPENDIX E

NASHVILLE-DAVIDSON COUNTY INDUSTRIAL PROCESS

HYDROCARBON EMISSIONS BY GRID, TONS/YEAR*

GI	Paint	Primer	Enamel	Varn/ shellac	Lacquer	Solvent	Ink	Gel-coat	Stain	Thinner	Other	Dry [illegible]	Tank [illegible]	Service [illegible]	Total
1A												[illegible]			[illegible]
3												0.80			0.80
4												1.42			1.42
5			12.13									3.90			16.03
6		0.09	46.54		0.47		0.20	4.00		0.33		10.93		99.4	165.53
7A												0.03			0.03
8A												12.19		28.4	40.59
10A	2.63	0.93	13.27		0.75	7.55	0.02				0.77	[illegible]		99.4	138.76
12												0.78			0.78
13												1.41			1.41
14A	13.23	10.41	9.06	0.70	0.36	0.05		2.64		5.51		[illegible]		99.4	170.80
15A												13.62		42.6	56.22
42												1.99	100.3		102.29
23												4.74		14.2	18.94
24												23.38		65.2	98.58
29						13.67						17.21		56.8	87.68
30A	3.01	2.66	10.15	0.93	1.05	14.50	2.60	30.00	0.14	3.06		14.58	1492.5	71.0	1652.38
31A	120.41	30.71	3.74		5.32	24.20	144.22			9.11		49.11	960.5	214.7	1551.45
34A	75.52	26.03	10.27	11.43	2.47	27.69	209.62			7.05		26.77	736.7	206.9	1353.37
35A		0.14	0.38		0.09	12.45	3.50			0.73		16.45		112.6	146.23
40A												17.06		16.2	33.26
41A		0.53	2.42		1.51	23.51	8.50					16.65		196.7	273.82
50A	18.69	14.44	10.02	0.51	2.38	30.41	4.46				0.02	47.19		154.5	318.72
51A	45.76	3.05	19.45			40.44	90.60			3.96		12.40		196.5	360.16
51A												0.19			0.19
53												6.48			6.48
64												25.04		99.4	124.44
65												0.66			0.66
66A	0.91	2.12				30.27	1.44			33.0		16.00		127.8	211.54
72A			6.18		1.30				0.26			17.04		65.2	103.48
73												7.50		65.2	92.70
												7.82		113.6	121.42
76												2.56			2.56
77												1.04			1.04
78												7.36			7.36
79												2.08			2.08
80												1.04			1.04
81												4.64			4.64
82												2.32		28.4	30.72
83	0.07	0.04			0.24							8.32			8.76
84												7.28			7.28
87												1.68			1.68
88												2.32			2.32
Tot	[illegible]	[illegible]	[illegible]	13.57	14.84	[illegible]	[illegible]	36.84	0.40	69.75	0.79	[illegible]	[illegible]	[illegible]	[illegible]

*Includes 32.35 tons of emissions from other miscellaneous sources. All values for GI's

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